REMARKS

Claims 1-11 and 13-19 are pending. Claim 12 has been cancelled without prejudice or disclaimer.

Initially, Applicants thank the Examiner for indicating that the drawing submitted on June 30, 2003 is acceptable, the allowance of claims 6-11, and for indicating the allowability of claims 12-17 if rewritten in independent form incorporating the limitations of the base claim and any intervening claims. As claim 1 has been amended to recite the features of claim 12, Applicants respectfully present that each pending claim currently recites allowable subject matter. As claim 19 depends from allowed claim 6, Applicants respectfully submit that claim 19 is also allowable.

Applicants additionally thank the Examiner for indicating that he would consider the documents attached to this Amendment.

In view of the above, it is respectfully submitted that all objections and rejections are overcome. Thus, a Notice of Allowance is respectfully requested.

Respectfully submitted,

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Date: November 28, 2003

ATTACHMENT - Additional Documents

U.S. PATENT NO. 6,465,046
HANSSON et al
ISSUED OCTOBER 15, 2002
TPP 31350

US006465046B1

(12) **United States Patent**
Hansson et al.

(10) **Patent No.: US 6,465,046 B1**
(45) **Date of Patent: Oct. 15, 2002**

(54) **PROCESS FOR ACHIEVING DECOR ON A SURFACE ELEMENT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(52) **U.S. Cl.** **427/256**; 427/258; 427/270
(58) **Field of Search** 427/8, 256, 258, 427/270

(56) **References Cited**

U.S. PATENT DOCUMENTS

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* cited by examiner

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(57) **ABSTRACT**

A process for achieving décor on surface elements (1) which comprises a decorative upper layer (2) and a supporting core (5). A segmentation pattern is selected, the segmentation comprising at least two décor segments on each surface element (1). The shape of the surface element (1), as seen from above, is selected from the group; triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal. The shape of the segments is selected from the group triangular, quadratic, rectangular, heptagonal, pentagonal, octagonal, circular, elliptical, perturbed and irregular. A segment décor is selected for each segment. The segment décor is selected from the group; digitised and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor. Each selection is made on a terminal where the selections emanates from a data base. The selection is visualised via the terminal.

13 Claims, 1 Drawing Sheet

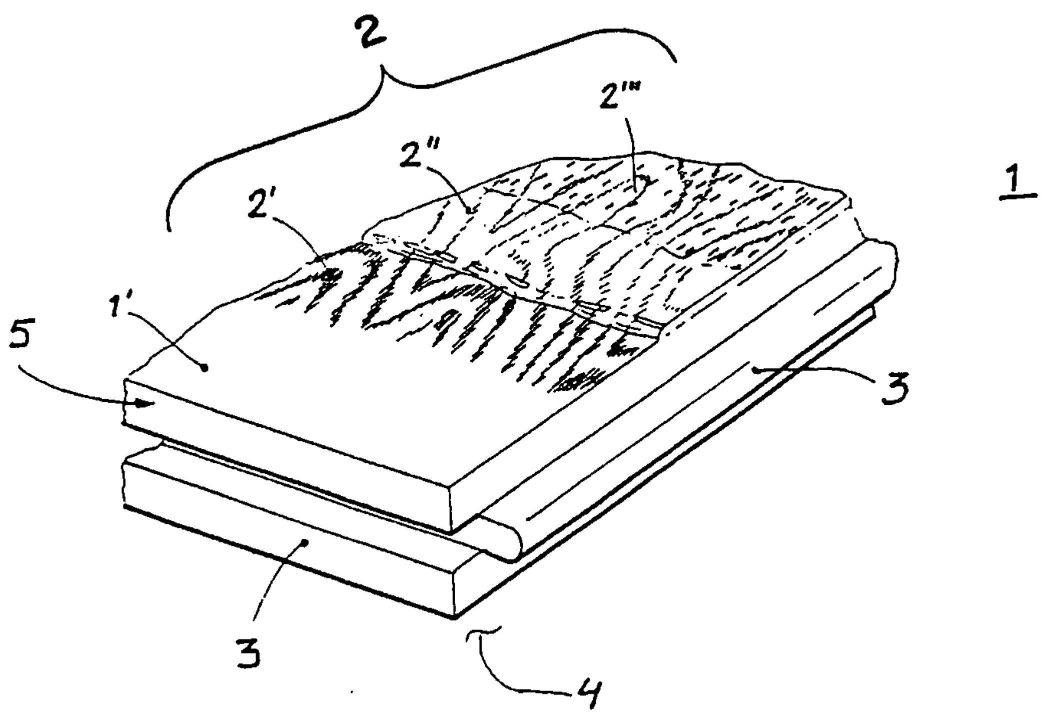
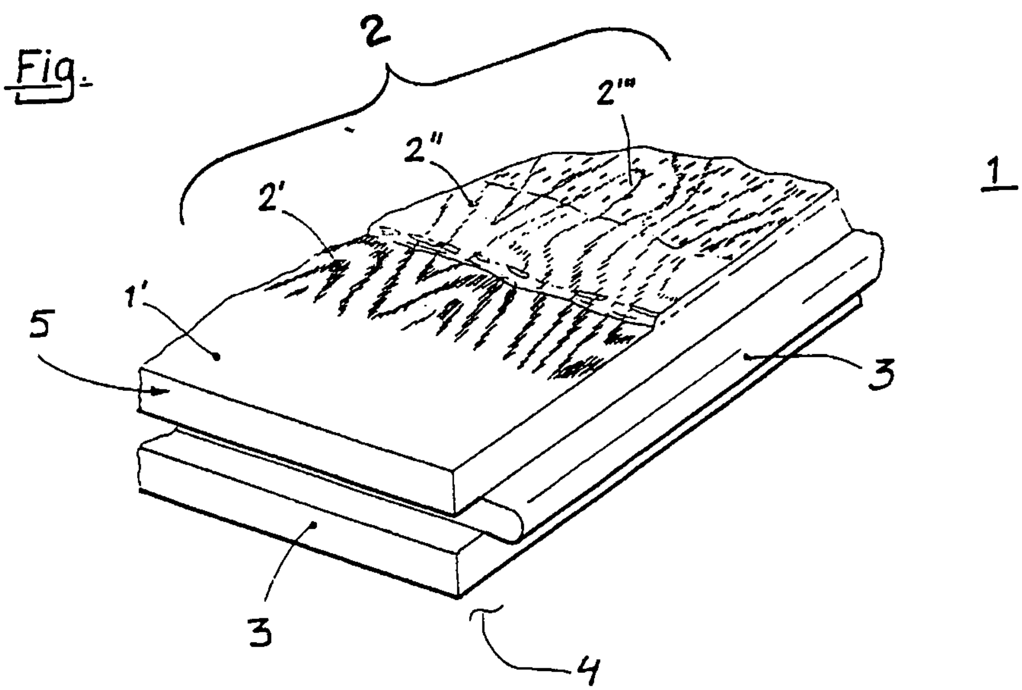


Fig.



PROCESS FOR ACHIEVING DECOR ON A SURFACE ELEMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a process for achieving decor on a surface element where a decorative upper surface have an considerably improved matching of the décor between adjacent surface elements.

2. Description of the Related Art

Products clad with thermosetting laminate is common in many areas nowadays. They are mostly used where the demands on abrasion resistance are high, and furthermore where resistance to different chemicals and moisture is desired. As examples of such products floors, floor skirting, table tops, work tops and wall panels can be mentioned.

The thermosetting laminate most often consist of a number of base sheets with a decor sheet placed closest to the surface. The decor sheet can be provided with a pattern by desire. Common patterns usually visualise different kinds of wood or mineral such as marble and granite.

One common pattern on floor elements is the rod pattern where two or more rows of rods of, for example wood, is simulated in the décor.

The traditional thermosetting laminate manufacturing includes a number of steps which will result in a random matching tolerance of up to ±5 mm, which is considered to great. The steps included in the manufacturing of a laminate floor is; printing decor on a paper of α-cellulose, impregnating the decorative paper with melamine-formaldehyde resin, drying the decorative paper, laminating the decorative paper under heat and pressure together with similarly treated supporting papers, applying the decorative laminate on a carrier and finally sawing and milling the carrier to the desired format. All these steps in the manufacturing will cause a change in format on the decor paper. It will therefore be practically impossible to achieve a desired match of patterns between the elements of a without causing great amounts of wasted laminate. The thermosetting laminate is a rather costly part of a laminate floor.

SUMMARY OF THE INVENTION

It has, through the present invention, been made possible to overcome the above mentioned problems and a surface element with a decorative surface where the decorative pattern between different surface elements is matching has been obtained. The invention relates to a process for achieving décor on surface elements which comprises a decorative upper layer and a supporting core. The invention is characterised in that;

i) A segmentation pattern is selected, the segmentation comprising at least two décor segments on each surface element. The shape, as seen from above, of the surface element is hereby selected from the group; triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal while the shape of the segments is selected from the group triangular, quadratic, rectangular, heptagonal, pentagonal, octagonal, circular, elliptical, perturbed and irregular.

ii) A segment décor is then selected for each segment. The segment décor is selected from the group; digitised and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor.

iii) Each selection is made on a terminal where the selections emanates from a data base and that the selection is visualised via the terminal.

The décor is preferably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is preferably stored digitally in order to be used as a control function and original, together with control programs and selection parameters, when printing the décor.

The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and support programs calculates an installation pattern. The installation pattern calculation is suitably also used for printing an assembly instruction. In order to visualise the selection the installation pattern calculation is possibly used for printing a miniaturised copy of the calculated installation with the selected pattern and décor. The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and that that support programs further calculates décor and segmentation pattern matching between the surface elements.

The selections is preferably also used, together with support programs for controlling further steps in the manufacturing procedure selected from the group; identification marking, positioning marking, packaging, lacquering, surface embossing, storing and delivery logistics.

An algorithm is suitably used for guiding the positioning of the décor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element. The control program is suitably used, together with décor data and selection parameters, for applying matching identification on the surface elements.

It is also possible to manufacture a designed larger surface with décor segments larger than a surface element by utilising the process as described below;

i) A selected main décor is entered via a terminal, the selected décor emanating from a group consisting of; an archetype digitised via digital camera or scanner and a digitised décor from a database.

ii) The dimensions of the surface to be covered by surface elements and the desired dimension of the décor is then entered into the terminal. Support programs are used for calculating the segmentation of the main décor to cover more than one surface element.

iii) The result of the selections and calculations is finally visualised via the terminal.

The digitised main décor is stored digitally in order to be used as a control function and original, together with control programs and selection parameters, when printing the décor.

It is, in order to enhance the decorative effect of some decor possible to select a surrounding décor. A décor effect in the border between the main décor and the surrounding décor is suitably also selected, the selection being made from the group; fading, sharp edge, sharp edge with shadow effect, jagged edge, jagged edge with shadow and surrounding inlay of other décor.

The surrounding décor is preferably processed as follows;

i) A segmentation pattern for the surrounding décor is selected. The segmentation comprising at least two décor segments on each surface element. The shape, as seen from above, of the surface element is preferably selected from the group; triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal. The shape of the surface elements with surrounding décor and the shape of the surface elements which, of course, is selected so that they can be joined with each other. The shape of the segments is selected from the group triangular, quadratic, rectangular, heptagonal, pentagonal, octagonal, circular, elliptical, perturbed and irregular.

ii) A segment décor is then selected for each segment. The segment décor is selected from the group; digitised and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor.

iii) Each selection is made on a terminal where the selections emanates from a data base. The selection is visualised via the terminal.

A décor effect in the border between the main décor and the surrounding décor is suitably selected. The selection is preferably made from the group; fading, sharp edge, sharp edge with shadow effect, jagged edge, jagged edge with shadow and surrounding inlay of other décor. Also this selection is made on the terminal.

The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and support programs calculates an installation pattern. The installation pattern calculation is preferably used for printing an assembly instruction. The installation pattern calculation is according to one embodiment of the invention used for printing a miniaturised copy of the calculated installation with the selected pattern and décor. This print out may serve as an evaluation copy of the design before making decisions regarding the manufacturing.

The dimensions of the surface to be covered by surface elements is entered into the terminal. Support programs further calculates décor and segmentation pattern matching between the surface elements. The selections is preferably used, together with support programs for controlling further steps in the manufacturing procedure selected from the group; identification marking, positioning marking, packaging, lacquering, surface embossing, storing and delivery logistics. An algorithm is preferably used for guiding the positioning of the décor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element. The control program is then preferably used together with décor data and selection parameters for applying matching identification on the surface elements.

The surface elements may be used as floor, wall or ceiling boards. The surface elements are suitably manufactured through the following process;

i) A supporting core with a desired format is manufactured and provided with an upper side and a lower side.

ii) The upper side of the supporting core is then provided with a décor, by for example printing. The décor is positioned after a predetermined fixing point on the supporting core.

iii) The upper side of the supporting core is then provided with a protecting, at least partly translucent, wear layer by for example spray coating, roller coating, curtain coating and immersion coating or by being provided with one or more sheets of α-cellulose impregnated with thermosetting resin or lacquer.

The décor is suitably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is stored digitally in order to be used as a control function and original, together with possible control programs, when printing the décor.

The décor may accordingly be obtained by making a high resolution or selected resolution digital picture of the desired décor. This is suitably made by means of a digital camera or scanner. The most common décor will of course be different kinds of wood and minerals like marble, as these probably will continue to be preferred surface décoration in home and public environments. It is, however, possible to depict anything that is visible. The digitised version of the décor is then edited to fit the size of the supporting core. It is also possible to rearrange the décor in many different ways, like changing colour tones, contrast, dividing the décor into smaller segments and adding other decorative elements. It is also possible to completely create the décor in a computer equipped for graphic design. It is possible to create a simulated décor so realistic that even a professional will have great problems in visually separating it from genuine material. This makes it possible to make for example floor boards with an almost perfect illusion of a rare kind of wood, like ebony or rose wood and still preserving trees under threat of extermination.

The digital décor is used together with guiding programs to control a printer. The printer may be of an electrostatic type or an inc-jet type printer. Most often the colours yellow, magenta, cyan and black will be sufficient for the printing process, but in some cases it might be advantageous to add white. Some colours are difficult to achieve using the colours yellow, magenta, cyan, black and white whereby the colours light magenta and light cyan may be added. It is also possible to add so called spot colours where specific colour tones are difficult to achieve or where only certain parts of the colour spectrum with intermixing shades is desired. The resolution needed is much depending on the décor that is to be simulated, but resolutions of 10–1500 dots per inch (dpi) is the practical range in which most décor will be printed. Under normal conditions a resolution of 300–800 dpi is sufficient when creating simulations of even very complex decorative patterns and still achieve a result that visually is very difficult to separate from the archetype without close and thorough inspection.

The digitally stored décor can also be used together with support programs when guiding other operations and procedures in the manufacturing process. Such steps in the operation may include procedures like identification marking, packaging, lacquering, surface embossing, storing and delivery logistics as well as assembly instructions.

DETAILED DESCRIPTION OF THE INVENTION

It is advantageous to manufacture the supporting core in the desired end user format and to provide it with edges suited for joining before applying the décor and wear layer, since the amount of waste thereby is radically reduced. The décor matching tolerances will also be improved further by this procedure.

The main part of the supporting core is suitably constituted by a particle board or a fibre board. It is, however, possible to manufacture the core that at least partly consist of a polymer such as for example polyurethane or a polyolefin such as polyethylene, polypropylene or polybutene. A polymer based core can be achieved by being injection moulded or press moulded and can be given its shape by plastic moulding and does therefore not require any abrasive treatment. A polymer based core may except polymer also contain a filler in the form of a particle or fibre of organic or inorganic material, which besides the use a cost reducing material also will be used to modify the mechanical characteristics of the core. As an example of such suitable fillers can be mentioned; cellulose or wood particles, straw, starch, glass, lime, talcum, stone powder and sand. The mechanical characteristics that may be changed is for example viscosity, thermal coefficient of expansion, elasticity, density, fire resistance, moisture absorption capacity, acoustic properties, thermal conductivity, flexural and shearing strength as well as softening temperature.

The upper surface, i.e. the surface that is to be provided with décor, is suitably surface treated before the printing.

Such surface treatment will then incorporate at least one of the steps, ground coating and sanding. It is also possible to provide the surface with a structure that matches the décor that is to be applied.

The translucent wear layer is suitably constituted by a UV- or electron beam curing lacquer such as an acrylic, epoxy, or maleimide lacquer. The wear layer is suitably applied in several steps with intermediate curing where the last one is a complete curing while the earlier ones are only partial. It will hereby be possible to achieve thick and plane layers. The wear layer suitably includes hard particles with an average particle size in the range 50 nm–150 μm. Larger particles, in the range 10 μm–150 μm, preferably in the range 30 μm–150 μm, is foremost used to achieve abrasion resistance while the smaller particles, in the range 50 nm–30 μm, preferably 50 nm–10 μm is used for achieving scratch resistance. The smaller particles is hereby used closest to the surface while the larger ones are distributed in the wear layer. The hard particles are suitably constituted of silicon carbide, silicon oxide, α-aluminium oxide and the like. The abrasion resistance is hereby increased substantially. Particles in the range 30 mm–150 mm can for example be sprinkled on still wet lacquer so that they at, least partly, becomes embedded in finished wear layer. It is therefore suitable to apply the wear layer in several steps with intermediate sprinkling stations where particles are added to the surface. The wear layer can hereafter be cured. It is also possible to mix smaller particles, normally particle sizes under 30 μm with a standard lacquer. Larger particles may be added if a gelling agent or the like is present. A lacquer with smaller particles is suitably used as top layer coatings, closer to the upper surface. The scratch resistance can be improved by sprinkling very small particles in the range 50 nm–1000 nm on the uppermost layer of lacquer. Also these, so called nano-particles, can be mixed with lacquer, which with is applied in a thin layer with a high particle content. These nano-particles may besides silicon carbide, silicon oxide and α-aluminium oxide also be constituted of diamond.

According to one embodiment of the invention, the translucent wear layer is constituted of one or more sheets of α-cellulose which are impregnated with melamine-formaldehyde resin. These sheets are joined with the core under heat and pressure whereby the resin cures. It is, also in this embodiment, possible to add hard particles with an average particle size in the range 50 nm–150 μm. Larger particles, in the range 10 μm–150 μm, preferably 30 μm–150 μm is foremost used to achieve abrasion resistance while the smaller of the particles, in the range 50 nm–30 μm, preferably 50 nm–10 μm, is used to achieve scratch resistance. The smaller particles is hereby used on, or very close to, the top surface while the larger particles may be distributed in the wear layer. Also here the particles advantageously are constituted of silicon carbide, silicon oxide, α-aluminium oxide, diamond or the like of which diamond, of cost reasons only is used as particles smaller than 1 μm. The sheets of α-cellulose is hereby suitably pressed together with the rest of the surface element in a continuos belt press with two steel belts. The pressure in the press is hereby suitably 5–100 Bar, preferably 20–80 Bar. The temperature is suitably in the range 140–200° C., preferably 160–180° C. It is also possible to utilise a discontinuous process where a number of surface elements can be pressed in a so called multiple-opening press at the same time. The pressure is then normally 20–150 Bar, preferably 70–120 Bar, while the temperature suitably is 120–180° C., preferably 140–160° C.

The décor on the surface elements is suitably constituted by a number of décor segments with intermediate borders, which borders, on at least two opposite edges coincides with intended, adjacent surface elements.

It is also desirable to provide the surface elements with a surface structure intended to increase the realism of the décor of the surface elements. This is suitably achieved by positioning at least one surface structured matrix, forming at least one surface structure segment on a corresponding décor segment or number of décor segments on the decorated surface of the surface element in connection to the application of wear layer. This matrix is pressed towards the wear layer whereby this will receive a surface with structure that enhances the realism of the décor.

When simulating more complex patterns, like wood block chevron pattern or other décor with two or more divergent and oriented décor, it is suitable to use at least two structured matrixes which forms one structure segment each. The structure segment are here independent from each other in a structure point of view. The surface structure segments are intended to at least partly but preferably completely match the corresponding décor segments of the décor. The surface structure segments are accurately positioned on the décor side of the surface element in connection to the application of the wear layer, and is pressed onto this whereby the wear layer is provided with a surface structure where the orientation of the structure corresponds to the different directions in the décor.

One or more matrixes preferably forms the surface of one or more rollers. The surface element is then passed between the roller or rollers and counter stay rollers, with the décor side facing the structured rollers. The structured rollers are continuously or discontinuously pressed towards the décor surface of the surface element.

Rollers containing two or more matrixes, is suitably provided with a circumference adapted to the repetition frequency of change of direction in the décor.

It is also possible to apply the structure matrixes on the surface of a press belt. The surface element is then passed between the press belt and a press belt counter stay under continuous or discontinuous pressure between the structured press belt and the press belt counter stay.

It is, according to one alternative procedure, possible to have one or more matrixes form the structure surface of one or more static moulds which momentary is pressed towards the decorative side of the surface element.

According to one embodiment of the invention, particularly characteristic décor segments such as borderlines between simulated slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor, is stored as digital data. Said data is used for guiding automated engraving or pressing tools when providing said characteristic décor segments with a suitable surface structure, and that said engraving tool or pressing tool is synchronised via the predetermined fixing point on the surface element.

The process described in the present application, for manufacturing surface elements is very advantageous from a logistic point of view since the number of steps when achieving a new décor is radically reduced. It is, according to the present invention possible to use digitally created or stored data for directly printing the décor on a surface element by using a ink-jet printer or a photo-static printer. The so-called set up time will thereby be very short, whereby even very special customer requirements may be met at a reasonable cost. It is according to the present invention possible to manufacture, for example, a world map in very large format, stretching over a great number of

surface elements without any disrupting deviations in décor matching, to mainly the same cost as bulk produced surface elements. Since the décor may be handled digitally all the way to the point of being applied to the surface of the core, set up times will be practically non-existent while at the same time a high degree of automation will be practicable. It is also possible to automatically provide the surface elements with identification and orientation marking which would make the installation of complex décor, like world maps in the example above, much easier. This has so far been impossible.

Surface elements manufactured as described above is suitably used as a floor covering material where the demands on stability and scratch and abrasion resistance is great. It is, according to the present invention, also possible to use the surface elements as wall and ceiling decorative material. It will however not be necessary to apply thick wear layer coatings in the latter cases as direct abrasion seldom occurs on such surfaces.

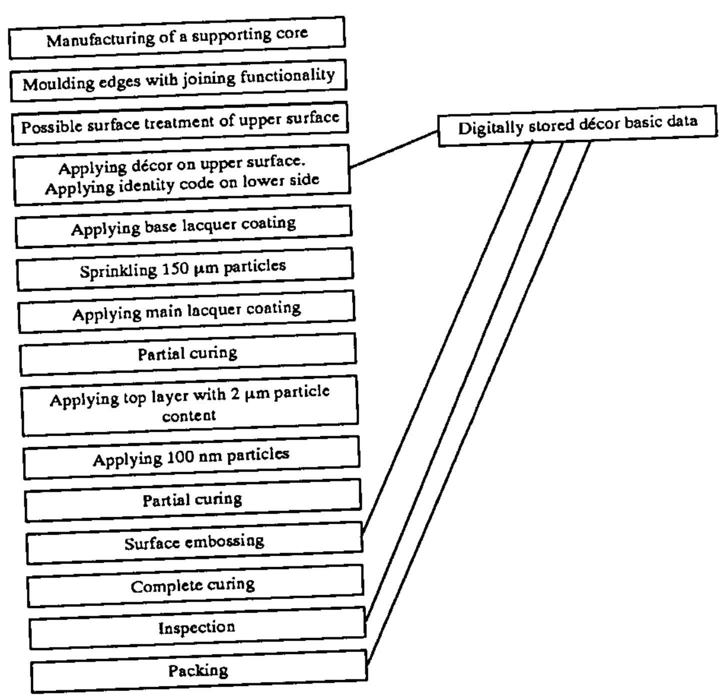
The invention is described further in connection to an enclosed figure, embodiment examples and schematic process descriptions showing different embodiments of the invention.

printing, utilising an inc-jet printer. The décor 2' is oriented after a predetermined fixing point on the supporting core 5. The upper side 1' of the supporting core 5 is then provided with a protecting translucent wear layer 2" through curtain coating. The supporting core 5 is constituted by particle board or fibre board. The translucent wear layer 2" is constituted by a UV-curing acrylic lacquer which is applied in several steps with intermediate curing, of which the last one is a complete curing while the earlier ones are only partial curing. The wear layer 2" also includes hard particles of α-aluminium oxide with an average particle size in the range 0,5 μm–150 μm.

A surface structured matrix is positioned and pressed towards the décor side of the surface element 1 before the final curing of the acrylic lacquer whereby the surface of the wear layer 2" receives a surface structure 2''' which enhances the realism of the décor 2'.

It is also possible to utilise two or more surface structured matrixes, each forming a structure segment, between which the structure is independent, which will make it possible to simulate the surface structure of, for example, wood block chevron pattern décor.

Process scheme 1.



BRIEF DESCRIPTION OF THE DRAWINGS

Accordingly, the FIGURE shows parts of a surface element 1 which includes an upper decorative layer 2, edges 3 intended for joining, a lower side 4 and a supporting core 5. The process is initiated by manufacturing a supporting core 5 with a desired format and edges 3 intended for joining. The supporting core 5 is further provided with an upper side 1' suited for printing and a lower side 4. The upper side 1' of the supporting core 5 is then provided with a décor 2' by

A supporting polymer and filler based core is manufactured in the desired format and is provided with an upper side, a lower side and edges provided with joining members, such as tongue and groove. The upper side of the supporting core is then sanded smooth after which a primer is applied. A décor is then applied on the upper side by means of a digital photo-static five colour printer. The colours are magenta, yellow, cyan, white and black. The décor is positioned from a predetermined fixing point in form of a corner of the

supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length is selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a supporting core. The digital image of the wood blocks are then classified after wood grain pattern and colour so that a number of groups is achieved. The groups are; fair wood with even grain, dark wood with even grain, fair wood with knots and flaws, dark wood with knots and flaws, fair cross-grained wood and finally dark cross-grained wood. Each group contains five different block simulations. An algorithm is feed into a computer which is used for the guiding of the printing operation so that the simulated wood blocks is digitally placed in three longitudinal rows and mixed so that two similar wood blocks never is placed next to each other. The algorithm will also guide the position of the latitudinal borderlines between the simulated wood blocks so that they are unaligned with more than one block width between adjacent rows. It will also guide the latitudinal position of the borderlines so that it either aligns with the shorter edges of the supporting core or is unaligned with more than one block width. Another printer, also guided by the computer, is utilised for printing a running matching number on the lower side short side edges. The décor will hereby continue longitudinally over the surface elements and a perfect matching is obtained when the surface elements are placed in numerical order.

A basic layer of UV-curing acrylic lacquer is then applied by means of a rollers. Particles with an average particle size in the range 150 μm is then sprinkled onto the still wet basic layer, whereby the main layer of UV-curing acrylic lacquer is applied by spray coating. The two layers of lacquer are then partly cured using UV-light whereby the viscosity of the lacquer increases. A top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 2 μm, is then applied by means of a roller. Hard particles with an average size of 100 nm is then sprinkled on top of the wet top layer, whereby the lacquer is partly cured with UV-light so that the viscosity increases. The still soft lacquer is then provided with a structure in the form of narrow, small, elongated recesses, simulating the pores of the wood. This will increase the realism of the décor. This is achieved by alternate between two different structured roller per row of simulated wood blocks. The structure of the rollers simulates even wood grain and cross-grained wood respectively. The rollers are alternately pressed towards the lacquered surface while it passes. The positioning of the rollers are guided via the digitally stored data used for printing the décor as well as the fixing point used there.

It is according to one alternative embodiment possible to utilise one or more static moulds with surface structure which momentary is pressed towards the décor side.

Especially characteristic décor segments such as borderlines between slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor, is suitably stored as digital data. This data is achieved by processing selected parts of the simulated wood blocks so that guiding data is achieved. Said data is then used for guiding an automated robot provided with an engraving tool or a press mould which provides the surface of the lacquer with a structure that matches said characteristic décor segments. The operation is also here synchronised via by the predetermined fixing point on the supporting core.

The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface elements may be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

The process above will make it possible to have a completely customer driven manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear to anyone skilled in the art, that a décor is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data. This will make it logistically possible to manufacture customer designed décor. Such a process is exemplified as follows;

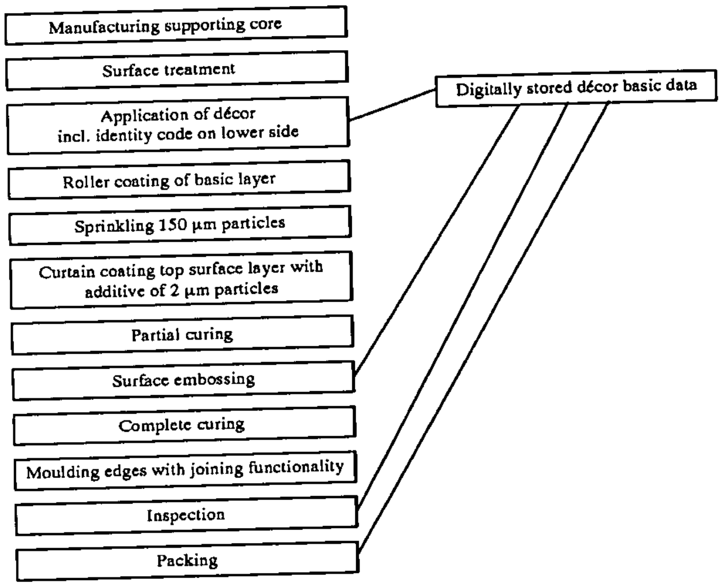
The customer utilises a database via Internet or at a local dealer. It is also possible for another operator utilise a database. The database contains samples and/or reduced resolution copies of a great variety of standard décor which can be combined after predetermined parameters.

The parameters may, for example, concern a single surface element where, for example, chevron pattern, diamond pattern and block pattern may be the choices of décor segmentation. It will here be possible to select a set of different simulations to randomly or by selected parameters fill the segments, for example, marble, birch and mahogany. The customer may also add an inlay from a design of his own which is digitised and processed, preferably automatically, to a desired format and resolution.

The parameters may alternatively include décor segments that requires the space of several surface elements, for example a map over the world. The parameters may here further include fading of the larger design to a surrounding décor, surrounding frame of other décor etc.

The customers enters the measurements of the surface that is to be covered by the surface elements. The customer then makes selections from the database and is able to see his selection as a completed surface, either on screen or by printing. The visualisation program used, is suitably also used for calculating installation pattern and presenting installation instructions with identification numbers on surface elements and where to cut the elements in order to make a perfect match. The surface elements may also be provided with removable matching lines on the decorative side making matching of décor between adjacent rows easier. The customer or dealer may then confirm his order via electronic mail where the pattern and décor is reduced to a code sequence and the order can be the direct input to the computer guiding the manufacturing process as described above. The customer and/or dealer data follows the manufacturing process all the way to packaging and a fully customer guided manufacturing process is achieved.

Process scheme 2



A supporting fibre board based core is manufactured in the desired format and is provided with an upper side, a lower side and edges. The upper side of the supporting core is then sanded smooth after which a white primer is applied. A décor is then applied on the upper side by means of a digital inc-jet four colour printer. The colours are magenta, yellow, cyan and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length are selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a finished surface element. The digital image of the wood blocks are then joined digitally to form a rectangular surface of a specified size, for example, 200×1200 mm. A selected amount of such combinations of different blocks are designed as described above so that a number of slightly different rectangular surfaces is achieved. The printer, or preferably a set of printers are positioned so that a desired number of rectangular décor surfaces with a specified intermediate distance is printed on the supporting core. The intermediate distance between the rectangular surfaces is the distance needed for parting and moulding of edges. The décor printer or printers are also used for printing fixing points at predetermined positions. Another printer, also guided by the computer, is utilised for printing an identity code on the lower side of each intended finished surface element.

A basic layer of UV-curing acrylic lacquer is then applied by means of rollers. Particles with an average particle size in the range 150 μm is then sprinkled onto the still wet basic layer, whereby a top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 2 μm, is applied by means of a roller. Hard particles with an average size of 100 nm is then sprinkled on top of the wet top layer, whereby the lacquer is partly cured with UV-light so that the viscosity increases. The still soft lacquer is then provided with a structure in the form of narrow, small, elongated recesses, simulating the pores of the wood. This will increase the realism of the décor. This is achieved by pressing rollers towards the lacquered surface while it passes. The positioning of the rollers are guided via the digitally stored data used for printing the décor, as well as the fixing point used there when more complex and completely matching surface structures as described together with process scheme 1 is desired.

The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface element is cut into the predetermined formats which are provided with edges with joining functionality are moulded by milling. The cutting and edge moulding process is positioned from fixing point printed close to the décor. The surface elements may then be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

It is, according to an alternative procedure in the process, possible to cut and mould the edges at an earlier stage in the process. It is suitable to apply and cure a protecting layer of lacquer on top of the printed décor followed by cutting and moulding of the edges. The remaining and main part of the wear layer is then applied as described in connection to process scheme 1 or 2 above.

The process above will make it possible to have a customer initiated manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear anyone skilled in the art, that décor is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data.

The invention is also described through embodiment examples.

EXAMPLE 1

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 30 g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20 g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70 μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30 g/m^2 of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20 g/m^2 of α-aluminium oxide particles with an average particle size of 70 μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate partial curing as a above. Each of the three layers had a surface weight of 20 g/m^2. The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10 μm. The first layer was applied to a surface weight of 10 g/m^2. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second layer of the topcoat lacquer was then applied and partly cured as described above. The wear layer was then provided with a surface structure by means of a surface structured roller. A third layer of the topcoat formulation was then applied on top of the structured wear layer. Also the third layer of top coat was applied to a surface weight of 10 g/m^2. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 7100 turns was obtained. An IP value of 7100 turns is fully sufficient for floor covering materials with medium to heavy traffic like hotel lobbies, hallways and the like.

EXAMPLE 2

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer. The build up of a wear layer was then initiated by applying 30 g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20 g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70 μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30 g/m^2 of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20 g/m^2 of α-aluminium oxide particles with an average particle size of 70 μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of 20 g/m^2. The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved. Also the uppermost of the three layers of lacquer was cured to a desired viscosity.

A second décor layer was then printed on top of the wear layer. The second décor layer, which was identical to the first décor closest to the core, was oriented and positioned so that it completely matched the first décor.

The build up of an upper wear layer was then initiated by applying 30 g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20 g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70 μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30 g/m^2 of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20 g/m^2 of α-aluminium oxide particles with an average particle size of 70 μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of 20 g/m^2. The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10 μm. The first layer was applied to a surface weight of 10 g/m^2. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second layer of the topcoat lacquer was then applied and partly cured as described above. The wear layer was then provided with a surface structure by means of a surface structured roller. A third layer of the topcoat formulation was then applied on top of the structured wear layer. Also the third layer of top coat was applied to a surface weight of 10 g/m^2. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 13500 turns was obtained. An IP value of 13500 turns is fully sufficient for floor covering materials with heavier traffic like airports, railway stations and the like. The second layer of décor and wear layer will add abrasion resistance without having obtained an unwanted hazy effect in the décor.

EXAMPLE 3

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 15 g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20 g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70 μm were sprinkled on the still sticky lacquer. The lacquer was

then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. One layer of UV-curing acrylic lacquer was then applied by roller coating and was partially cured as above. The layer had a surface weight of 40 g/m^2. The hard particles were embedded in the lacquer after the layer of lacquer was applied and a mainly plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10 μm. The first layer was applied to a surface weight of 10 g/m^2. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. The wear layer was then provided with a surface structure by means of a surface structured roller. A second, final layer of the topcoat formulation was then applied on top of the structured wear layer. Also the second layer of top coat was applied to a surface weight of 10 g/m^2. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 3100 turns was obtained. An IP value of 3100 turns is fully sufficient for floor covering materials with light traffic like bedrooms, living rooms and the like.

EXAMPLE 4

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 50 g/m^2 of UV-curing acrylic lacquer which contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10 μm by means of roller coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layer. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10 μm. The first layer was applied to a surface weight of 10 g/m^2. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. The wear layer was then provided with a surface structure by means of a surface structured roller. A second, final layer of the topcoat formulation was then applied on top of the structured wear layer. Also the second layer of top coat was applied to a surface weight of 10 g/m^2. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 300 turns was obtained. An IP value of 300 turns could be sufficient for floor covering materials with light traffic like bedrooms, living rooms and the like.

The invention is not limited to the embodiments shown as these can be varied in different ways within the scope of the invention. It is for example possible to use so-called overlay sheets of α-cellulose impregnated with thermosetting resin instead of acrylic lacquer in the process described in connection to process scheme 1 and in particular in the process described in connection to process scheme 2. These sheets of a-cellulose which are impregnated with melamine-formaldehyde resin is joined with the supporting core through heat and pressure, whereby the resin cures. The wear resistance may also in this embodiment be improved by adding hard particles in the range 50 nm–150 μm to the wear layer.

What is claimed is:

1. A process for achieving décor for surface elements (1) to be installed over a surface to be covered, the surface elements having a surface which comprise a decorative upper layer (2) and a supporting core (5), said process comprising the steps of:

i) selecting a segmentation pattern, the segmentation pattern comprising at least two décor segments on each surface element (1), wherein the shape, as seen from above, of the surface element (1) is selected from the group consisting of triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal while the shape of the segments is selected from the group consisting of triangular, quadratic, rectangular, heptagonal, pentagonal, octagonal, circular, elliptical, perturbed and irregular,

ii) selecting a segment décor for each segment, wherein the segment décor is selected from the group consisting of digitized and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor,

iii) each selection is made on a terminal where the selections emanate from a data base and that the selection is visualized via the terminal and,

iv) applying the selected décor on said surface elements.

2. A process according to claim 1, wherein the décor is achieved by digitization of an actual archetype or by partly or completely being created in a digital media, which digitized décor (2') is stored digitally in order to be used a as a control function and original, together with control programs and selection parameters, when printing the décor (2').

3. A process according to claim 2, wherein the dimensions of the surface to be covered by surface elements (1) is entered into the terminal and a program calculates an installation pattern.

4. A process according to claim 3, wherein the installation pattern calculation is used for printing an assembly instruction.

5. A process according to claim 3, wherein the installation pattern calculation is used for printing a miniaturized copy of the calculated installation pattern with the selected segmentation pattern and décor.

6. A process according to claim 3, wherein the dimensions of the surface to be covered by surface elements (1) are entered into the terminal and the program further calculates the segmentation pattern matching between the surface elements (1).

7. A process according to claim 2, further comprising using the selection parameters, together with the program, to control further steps, said further steps consisting of at least one selected from the group consisting of identification marking, positioning marking, packaging, lacquering, surface embossing, storing and delivery logistics.

8. A process according to claim 3, wherein an algorithm is used for guiding positioning of the décor and segmentation pattern so that a décor from one surface element may continue on an adjoining surface element.

9. A process according to 8, wherein the program is used together with décor and selection parameters for applying matching identification on the surface elements (1).

10. A process according to claim 4, wherein an algorithm is used for guiding the positioning of the decor segments and segmentation pattern so that a decor segment from one surface element may continue on an adjoining surface element.

11. A process according to claim 5, wherein an algorithm is used for guiding the positioning of the decor segments and segmentation pattern so that a decor segment from one surface element may continue on an adjoining surface element.

12. A process according to claim 6, wherein an algorithm is used for guiding the positioning of the decor segments and segmentation pattern so that a decor segment from one surface element may continue on an adjoining surface element.

13. A process according to claim 7, wherein an algorithm is used for guiding the positioning of the decor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element.

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(54) **PROCESS FOR THE MANUFACTURING OF SURFACE ELEMENTS**

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(58) **Field of Search** 427/258, 262, 427/264, 267, 270, 277, 278, 204, 205, 203, 420, 421, 428, 430, 440; 428/206, 208

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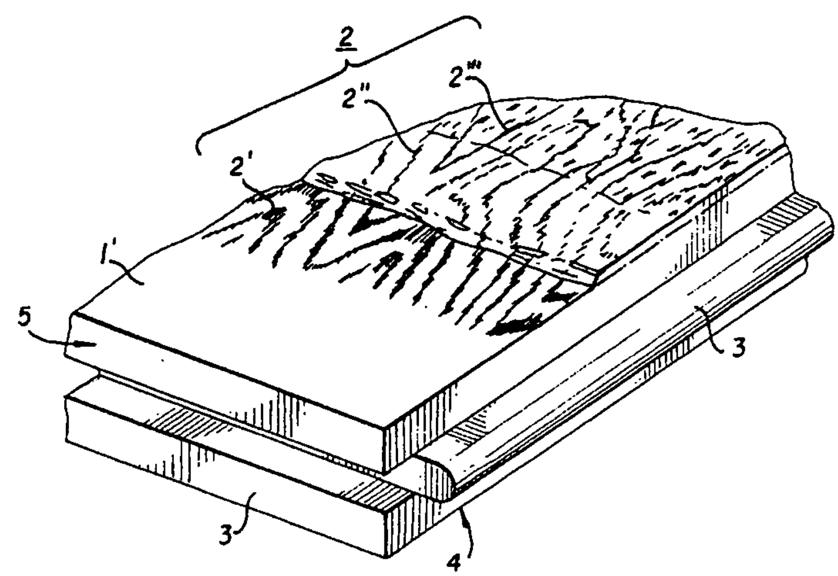
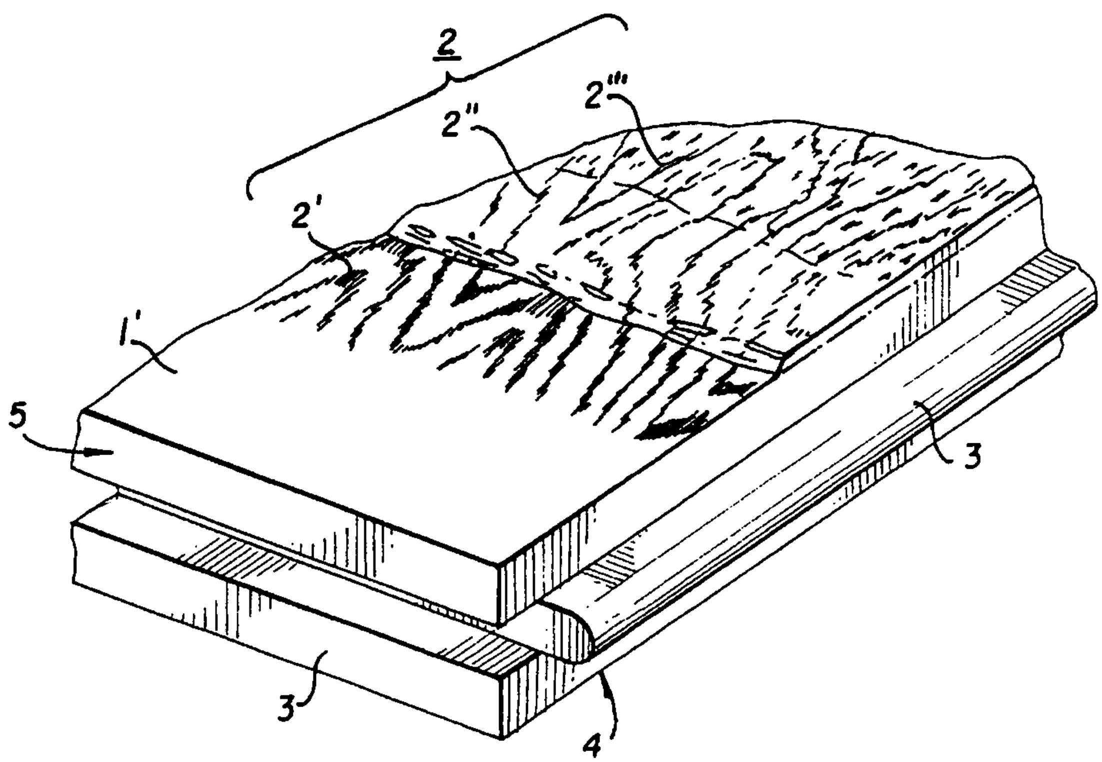
(57) **ABSTRACT**

A process for the manufacturing of surface elements (1) which comprises a decorative upper layer (2) and a supporting core (5). A supporting core (5) with a desired format is manufactured and provided with an upper side (1') and a lower side (4). The upper side (1') of the supporting core (5) is provided with a décor , by for example printing, which décor (2') is positioned after a predetermined fixed point on the supporting core (5). The upper side (1') of the supporting core (5) is provided with a protecting, at least partly translucent, wear layer (2") by for example spray coating, roller coating, curtain coating and immersion coating or by being provided with one or more sheets of α-cellulose impregnated with thermosetting resin or lacquer.

39 Claims, 1 Drawing Sheet

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PROCESS FOR THE MANUFACTURING OF SURFACE ELEMENTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a process for the manufacturing of surface elements with a decorative upper surface of which the decorative elements have an considerably improved matching of the décor between adjacent surface elements.

2. Description of the Related Art

Products clad with thermosetting laminate is common in many areas nowadays. They are mostly used where the demands on abrasion resistance are high, and furthermore where resistance to different chemicals and moisture is desired. As examples of such products floors, floor skirtings, table tops, work tops and wall panels can be mentioned.

The thermosetting laminate most often consist of a number of base sheets with a decor sheet placed closest to the surface. The decor sheet can be provided with a pattern by desire. Common patterns usually visualise different kinds of wood or mineral such as marble and granite.

One common pattern on floor elements is the rod pattern where two or more rows of rods of, for example wood, is simulated in the décor .

The traditional thermosetting laminate manufacturing includes a number of steps which will result in a random matching tolerance of up to ±5 mm, which is considered too great. The steps included in the manufacturing of a laminate floor is: printing decor on a paper of α-cellulose, impregnating the decorative paper with melamine-formaldehyde resin, drying the decorative paper, laminating the decorative paper under heat and pressure together with similarly treated supporting papers, applying the decorative laminate on a carrier and finally sawing and milling the carrier to the desired format. All these steps in the manufacturing will cause a change in format on the decor paper. It will, therefore, be practically impossible to achieve a desired match of patterns between adjacent elements causing great amounts of wasted laminate. Naturally, this waste is not desirable, as the thermosetting laminate is a rather costly part of a laminate floor.

SUMMARY OF THE INVENTION

It has, through the present invention, been made possible to overcome the above mentioned problems and provide a surface element with a decorative surface where the decorative pattern between different surface elements with matching of the decorative pattern can be obtained. The invention relates to a process for the manufacturing of surface elements which surface elements comprise a decorative upper layer and a support core. The surface elements may be used as floor, wall or ceiling boards. The invention is characterised in that:

i) A supporting core with a desired format is manufactured and provided with an upper side and a lower side.

ii) The upper side of the support core is then provided with a décor , by, for example, printing. The décor is positioned after a predetermined fixing point on the support core.

iii) The upper side of the supporting core is then provided with a protecting, at least partly translucent, wear layer by, for example, spray coating, roller coating, curtain coating and immersion coating or by being provided with one or more sheets of α-cellulose impregnated with thermosetting resin or lacquer.

The décor is suitably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is stored digitally in order to be used as a control function and original, together with possible control programs, when printing the décor.

The décor may accordingly be obtained by making a high resolution or selected resolution digital picture of the desired decor. This is suitably made by means of a digital camera or scanner. The most common décor will of course be different kinds of wood and minerals like marble, as these probably will continue to be preferred surface decoration in home and public environments. It is, however, possible to depict anything that is visible. The digitised version of the décor is then edited to fit the size of the supporting core. It is also possible to rearrange the décor in many different ways, like changing colour tones, contrast, dividing the décor into smaller segments and adding other decorative elements. It is also possible to completely create the décor in a computer equipped for graphic design. It is possible to create a simulated décor so realistic that even a professional will have great problems in visually separating it from genuine material. This makes it possible to make for example floor boards with an almost perfect illusion of a rare kind of wood, like ebony or rose wood and still preserving trees under threat of extermination.

The digital décor is used together with guiding programs to control a printer. The printer may be of an electrostatic type or an ink-jet type printer. Most often the colours yellow, magenta, cyan and black will be sufficient for the printing process, but in some cases it might be advantageous to add white. Some colours are difficult to achieve using the colours yellow, magenta, cyan, black and white whereby the colours light magenta and light cyan may be added. It is also possible to add so called spot colours where specific colour tones are difficult to achieve or where only certain parts of the colour spectrum with intermixing shades is desired. The resolution needed is much depending on the décor that is to be simulated, but resolutions of 10–1500 dots per inch (dpi) is the practical range in which most décors will be printed. Under normal conditions a resolution of 300–800 dpi is sufficient when creating simulations of even very complex decorative patterns and still achieve a result that visually is very difficult to separate from the archetype without close and thorough inspection.

The digitally stored décor can also be used together with support programs when guiding other operations and procedures in the manufacturing process. Such steps in the operation may include procedures like identification marking, packaging, lacquering, surface embossing, storing and delivery logistics as well as assembly instructions.

It is advantageous to manufacture the supporting core in the desired end user format and to provide it with edges suited for joining before applying the décor and wear layer, since the amount of waste thereby is radically reduced. The décor matching tolerances will also be improved further by this procedure.

The main part of the support core is suitably constituted by a particle board or a fibre board. It is, however, possible to manufacture the core that at least partly consists of a polymer, such as, for example, polyurethane or a polyolefin, such as, polyethylene, polypropylene or polybutene. A polymer based core can be achieved by being injection moulded or press moulded and can be given its shape by plastic moulding and does, therefore, not require any abrasive treatment. A polymer based core may also contain a filler in

the form of a particle or fibre of organic or inorganic material, which, besides its use as a cost reducing material, also can be used to modify the mechanical characteristics of the core. As an example of such suitable fillers can be mentioned; cellulose or wood particles, straw, starch, glass, lime, talcum, stone powder and sand. The mechanical characteristics that may be changed are, for example, viscosity, thermal coefficient of expansion, elasticity, density, fire resistance, moisture absorption capacity, acoustic properties, thermal conductivity, flexural and shearing strengths as well as softening temperature.

The upper surface, i.e. the surface that is to be provided with décor, is suitably surface treated before the printing. Such surface treatment will then incorporate at least one of the steps, ground coating and sanding. It is also possible to provide the surface with a structure that matches the décor that is to be applied.

The translucent wear layer is suitably constituted by a UV- or electron beam curing lacquer such as an acrylic, epoxy, or maleimide lacquer. The wear layer is suitably applied in several steps with intermediate curing where the last one is a complete curing while the earlier ones are only partial. It will hereby be possible to achieve thick and plane layers. The wear layer suitably includes hard particles with an average particle size in the range 50 nm–150 μm. Larger particles, in the range 10 μm–150 μm, preferably in the range 30 μm–150 μm, are used to achieve abrasion resistance while the smaller particles, in the range 50 nm–30 μm, preferably 50 nm–10 μm is used for achieving scratch resistance. The smaller particles is hereby used closest to the surface while the larger ones are distributed in the wear layer. The hard particles are suitably constituted of silicon carbide, silicon oxide, α-aluminium oxide and the like. The abrasion resistance is hereby increased substantially. Particles in the range 30 mm–150 mm can for example be sprinkled on still wet lacquer so that they at, least partly, become embedded in the finished wear layer. It is therefore suitable to apply the wear layer in several steps with intermediate sprinkling stations where particles are added to the surface. The wear layer can hereafter be cured. It is also possible to mix smaller particles, normally particle sizes under 30 μm with a standard lacquer. Larger particles may be added if a gelling agent or the like is present. A lacquer with smaller particles is suitably used as top layer coatings, closer to the upper surface. The scratch resistance can be improved by sprinkling very small particles in the range 50 nm–1000 nm on the uppermost layer of lacquer. Also these, so called nano-particles, can be mixed with lacquer, which with is applied in a thin layer with a high particle content. These nano-particles may besides silicon carbide, silicon oxide and α-aluminium oxide also be constituted of diamond.

According to one embodiment of the invention, the translucent wear layer is constituted of one or more sheets of α-cellulose which are impregnated with melamine-formaldehyde resin. These sheets are joined with the core under heat and pressure whereby the resin cures. It is, also in this embodiment, possible to add hard particles with an average particle size in the range 50 nm–150 μm. Larger particles, in the range 10 μm–150 μm, preferably 30 μm–150 μm, is foremost used to achieve abrasion resistance while the smaller of the particles, in the range 50 nm–30 μm, preferably 50 nm–10 μm, is used to achieve scratch resistance. The smaller particles is hereby used on, or very close to, the top surface while the larger particles may be distributed in the wear layer. Also, here the particles advantageously are constituted of silicon carbide, silicon oxide, α-aluminium oxide, diamond or the like of which diamond, for cost reasons only is used as particles smaller than 1 μm. The sheets of α-cellulose is hereby suitably pressed together with the rest of the surface element in a continuous belt press with two steel belts. The pressure in the press is hereby suitable 5–100 Bar, preferably 20–80 Bar. The temperature is suitably in the range 140–200° C. It is also possible to utilize a discontinuous process where a number of surface elements can be pressed in a so called multiple-opening press at the same time. The pressure is then normally 20–150 Bar, preferably 70–120 Bar, while the temperature suitably is 120–180° C., preferably 140–160° C.

The décor on the surface elements is suitably constituted by a number of décor segments with intermediate borders, which borders, on at least two opposite edges coincide with intended, adjacent surface elements.

It is also desirable to provide the surface elements with a surface structure intended to increase the realism of the décor of the surface elements. This is suitably achieved by positioning at least one surface structured matrix, forming at least one surface structure segment on a corresponding décor segment or number of décor segments on the decorated surface of the surface element in connection to the application of wear layer. This matrix is pressed towards the wear layer whereby this will receive a surface with structure that enhances the realism of the décor.

When simulating more complex patterns, like wood block chevron pattern or other décors with two or more divergent and oriented décors, it is suitable to use at least two structured matrixes which forms one structure segment each. The structure segment are here independent from each other in a structure point of view. The surface structure segments are intended to at least partly but preferably completely match the corresponding décor segments of the décor. The surface structure segments are accurately positioned on the décor side of the surface element in connection to the application of the wear layer, and is pressed onto this whereby the wear layer is provided with a surface structure where the orientation of the structure corresponds to the different directions in the décor.

One or more matrixes preferably forms the surface of one or more rollers. The surface element is then passed between the roller or rollers and counter stay rollers, with the décor side facing the structured rollers. The structured rollers are continuously or discontinuously pressed towards the décor surface of the surface element.

Rollers containing two or more matrixes, is suitably provided with a circumference adapted to the repetition frequency of change of direction in the décor.

It is also possible to apply the structure matrixes on the surface of a press belt. The surface element is then passed between the press belt and a press belt counter stay under continuous or discontinuous pressure between the structured press belt and the press belt counter stay.

It is, according to one alternative procedure, possible to have one or more matrixes form the structure surface of one or more static moulds which momentary is pressed towards the decorative side of the surface element.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

According to one embodiment of the invention, particularly characteristic décor segments such as borderlines

between simulated slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor, are stored as digital data. Said data are used for guiding automated engraving or pressing tools when providing said characteristic décor segments with a suitable surface structure, and that said engraving tool or pressing tool is synchronised via the predetermined fixing point on the surface element.

The process described in the present application, for manufacturing surface elements is very advantageous from a logistic point of view since the number of steps when achieving a new décor is radically reduced. It is, according to the present invention possible to use digitally created or stored data for directly printing the décor on a surface element by using a ink-jet printer or a photo-static printer. The so-called set up time will thereby be very short, whereby even very special customer requirements may be met at a reasonable cost. It is according to the present invention possible to manufacture, for example, a world map in very large format, stretching over a great number of surface elements without any disrupting deviations in décor matching, to mainly the same cost as bulk produced surface elements. Since the décor may be handled digitally all the way to the point of being applied to the surface of the core, set up times will be practically non-existent while at the same time a high degree of automation will be practicable. It is also possible to automatically provide the surface elements with identification and orientation marking which would make the installation of complex décors, like world maps in the example above, much easier. This has so far been impossible.

The décor on the surface elements may be processed as follows;

i) A segmentation pattern is selected, the segmentation comprising at least two décor segments on each surface element. The shape, as seen from above, of the surface element is hereby selected from the group; triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal while the shape of the segments is selected from the group triangular, quadratic, rectangular, heptagonal, pentagonal, octagonal, circular, elliptical, perturbed and irregular.

ii) A segment décor is then selected for each segment. The segment décor is selected from the group; digitised and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor.

iii) Each selection is made on a terminal where the selections emanates from a data base and that the selection is visualised via the terminal.

The décor is preferably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is preferably stored digitally in order to be used as a control function and original, together with control programs and selection parameters, when printing the décor.

The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and support programs calculates an installation pattern. The installation pattern calculation is suitably also used for printing an assembly instruction. In order to visualise the selection the installation pattern calculation is possibly used for printing a miniaturised copy of the calculated installation with the selected pattern and décor. The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and that that support programs further calculates décor and segmentation pattern matching between the surface elements.

The selections is preferably also used, together with support programs for controlling further steps in the manufacturing procedure selected from the group; identification marking, positioning marking, packaging, lacquering, surface embossing, storing and delivery logistics.

An algorithm is suitably used for guiding the positioning of the décor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element. The control program is suitably used, together with décor data and selection parameters, for applying matching identification on the surface elements.

Surface elements manufactured as described above is suitably used as a floor covering material where the demands on stability and scratch and abrasion resistance is great. It is, according to the present invention, also possible to use the surface elements as wall and ceiling decorative material. It will however not be necessary to apply thick wear layer coatings in the latter cases as direct abrasion seldom occurs on such surfaces.

The invention is described further in connection to an enclosed FIGURE, embodiment examples and schematic process descriptions showing different embodiments of the invention.

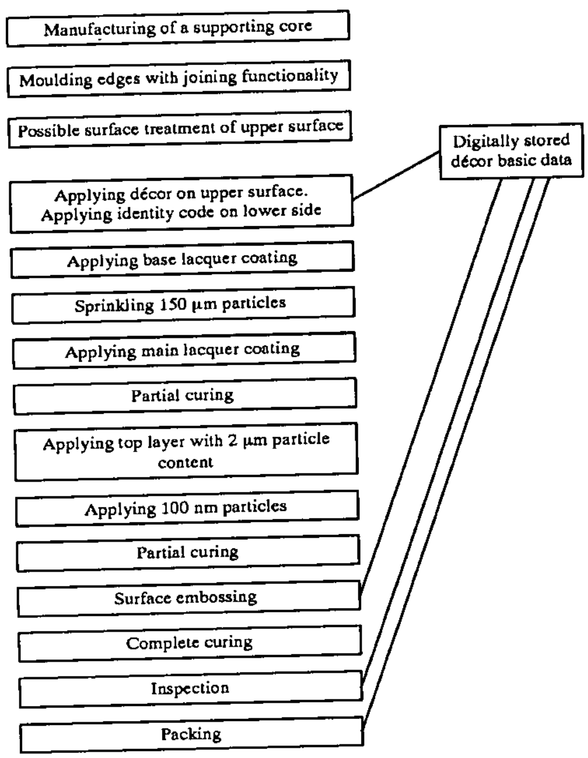
BRIEF DESCRIPTION OF THE DRAWINGS

Accordingly, the FIGURE shows parts of a surface element **1** which includes an upper decorative layer **2**, edges **3** intended for joining, a lower side **4** and a supporting core **5**. The process is initiated by manufacturing a supporting core **5** with a desired format and edges **3** intended for joining. The supporting core **5** is further provided with an upper side **1'** suited for printing and a lower side **4**. The upper side **1'** of the supporting core **5** is then provided with a décor **2'** by printing, utilizing an ink-jet printer. The décor **2'** is oriented after a predetermined fixing point on the supporting core **5**. The upper side **1'** of the supporting core **5** is then provided with a protecting translucent wear layer **2"** through curtain coating. The supporting core **5** is constituted by particle board or fibre board. The translucent wear layer **2"** is constituted by a UV-curing acrylic lacquer which is applied in several steps with intermediate curing, of which the last one is a complete curing while the earlier ones are only partial curing. The wear layer **2"** also includes hard particles of α-aluminium oxide with an average particle size in the range 0.5 μm–150 μm.

A surface structured matrix is positioned and pressed towards the décor side of the surface element **1** before the final curing of the acrylic lacquer whereby the surface of the wear layer **2"** receives a surface structure **2'"** which enhances the realism of the décor **2'**.

It is also possible to utilise two or more surface structured matrixes, each forming a structure segment, between which the structure is independent, which will make it possible to simulate the surface structure of, for example, wood block chevron pattern décor.

Process scheme 1.



A supporting polymer and filler based core is manufactured in the desired format and is provided with an upper side, a lower side and edges provided with joining members, such as tongue and groove. The upper side of the supporting core is then sanded smooth after which a primer is applied. A décor is then applied on the upper side by means of a digital photo-static five colour printer. The colours are magenta, yellow, cyan, white and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length is selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a supporting core. The digital image of the wood blocks are then classified after wood grain pattern and colour so that a number of groups is achieved. The groups are; fair wood with even grain, dark wood with even grain, fair wood with knots and flaws, dark wood with knots and flaws, fair cross-grained wood and finally dark cross-grained wood. Each group contains five different block simulations. An algorithm is feed into a computer which is used for the guiding of the printing operation so that the simulated wood blocks is digitally placed in three longitudinal rows and mixed so that two similar wood blocks never is placed next to each other. The algorithm will also guide the position of the latitudinal borderlines between the simulated wood blocks so that they are unaligned with more than one block width between adjacent rows. It will also guide the latitudinal position of the borderlines so that it either aligns with the shorter edges of the supporting core or is unaligned with more than one block width. Another printer, also guided by the computer, is utilised for printing a running matching number on the lower side short side edges. The décor will hereby continue longitudinally over the surface elements and a perfect matching is obtained when the surface elements are placed in numerical order.

A basic layer of UV-curing acrylic lacquer is then applied by means of a rollers. Particles with an average particle size in the range 150 μm is then sprinkled onto the still wet basic layer, whereby the main layer of UV-curing acrylic lacquer is applied by spray coating. The two layers of lacquer are then partly cured using UV-light whereby the viscosity of the lacquer increases. A top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 2 μm, is then applied by means of a roller. Hard particles with an average size of 100 nm is then sprinkled on top of the wet top layer, whereby the lacquer is partly cured with UV-light so that the viscosity increases. The still soft lacquer is then provided with a structure in the form of narrow, small, elongated recesses, simulating the pores of the wood. This will increase the realism of the decor. This is achieved by alternate between two different structured roller per row of simulated wood blocks. The structure of the rollers simulates even wood grain and cross-grained wood respectively. The rollers are alternately pressed towards the lacquered surface while it passes. The positioning of the rollers are guided via the digitally stored data used for printing the décor as well as the fixing point used there.

It is according to one alternative embodiment possible to utilise one or more static moulds with surface structure which momentary is pressed towards the décor side.

Especially characteristic décor segments such as borderlines between slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor, is suitably stored as digital data. This data is achieved by processing selected parts of the simulated wood blocks so that guiding data is achieved. Said data is then used for guiding an automated robot provided with an engraving tool or a press mould which provides the surface of the lacquer with a structure that matches said characteristic décor segments. The operation is also here synchronised via by the predetermined fixing point on the supporting core.

The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface elements may be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

The process above will make it possible to have a completely customer driven manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear to anyone skilled in the art, that a décor is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data. This will make it logistically possible to manufacture customer designed decors. Such a process is exemplified as follows;

The customer utilises a database via Internet or at a local dealer. It is also possible for another operator utilise a

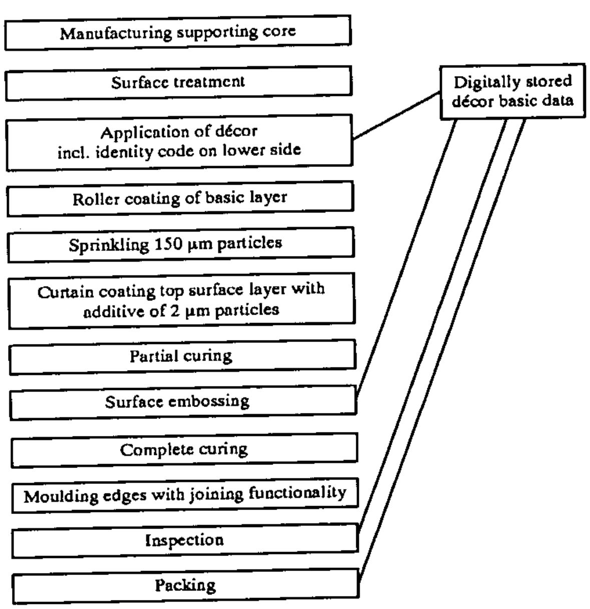
database. The database contains samples and/or reduced resolution copies of a great variety of standard decors which can be combined after predetermined parameters.

The parameters may, for example, concern a single surface element where, for example, chevron pattern, diamond pattern and block pattern may be the choices of décor segmentation. It will here be possible to select a set of different simulations to randomly or by selected parameters fill the segments, for example, marble, birch and mahogany. The customer may also add an inlay from a design of his own which is digitised and processed, preferably automatically, to a desired format and resolution.

The parameters may alternatively include décor segments that requires the space of several surface elements, for example a map over the world. The parameters may here further include fading of the larger design to a surrounding decor, surrounding frame of other décor etc.

The customer enters the measurements of the surface that is to be covered by the surface elements. The customer then makes selections from the database and is able to see his selection as a completed surface, either on screen or by printing. The visualisation program used, is suitably also used for calculating installation pattern and presenting installation instructions with identification numbers on surface elements and where to cut the elements in order to make a perfect match. The surface elements may also be provided with removable matching lines on the decorative side making matching of décor between adjacent rows easier. The customer or dealer may then confirm his order via electronic mail where the pattern and décor is reduced to a code sequence and the order can be the direct input to the computer guiding the manufacturing process as described above. The customer and/or dealer data follows the manufacturing process all the way to packaging and a fully customer guided manufacturing process is achieved.

Process scheme 2



A supporting fibre board based core is manufactured in the desired format and is provided with an upper side, a lower side and edges. The upper side of the supporting core is then sanded smooth after which a white primer is applied. A décor is then applied on the upper side by means of a digital ink-jet four colour printer. The colours are magenta, yellow, cyan and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length are selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a finished surface element. The digital image of the wood blocks are then joined digitally to form a rectangular surface of a specified size, for example, 200×1200 mm. A selected amount of such combinations of different blocks are designed as described above so that a number of slightly different rectangular surfaces is achieved. The printer, or preferably a set of printers are positioned so that a desired number of rectangular décor surfaces with a specified intermediate distance is printed on the supporting core. The intermediate distance between the rectangular surfaces is the distance needed for parting and moulding of edges. The décor printer or printers are also used for printing fixing points at predetermined positions. Another printer, also guided by the computer, is utilised for printing an identity code on the lower side of each intended finished surface element.

A basic layer of UV-curing acrylic lacquer is then applied by means of rollers. Particles with an average particle size in the range 75 μm is then sprinkled onto the still wet basic layer, whereby a top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 2 μm, is applied by means of a roller. Hard particles with an average size of 100 nm is then sprinkled on top of the wet top layer, whereby the lacquer is partly cured with UV-light so that the viscosity increases. The still soft lacquer is then provided with a structure in the form of narrow, small, elongated recesses, simulating the pores of the wood. This will increase the realism of the décor. This is achieved by pressing rollers towards the lacquered surface while it passes. The positioning of the rollers are guided via the digitally stored data used for printing the décor, as well as the fixing point used there when more complex and completely matching surface structures as described together with process scheme 1 is desired.

The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface element is cut into the predetermined formats which are provided with edges with joining functionality are moulded by milling. The cutting and edge moulding process is positioned from fixing point printed close to the decor. The surface elements may then be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

It is, according to an alternative procedure in the process, possible to cut and mould the edges at an earlier stage in the process. It is suitable to apply and cure a protecting layer of lacquer on top of the printed décor followed by cutting and moulding of the edges. The remaining and main part of the wear layer is then applied as described in connection to process scheme 1 or 2 above.

The process above will make it possible to have a customer initiated manufacturing where even very small quan-

tities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear anyone skilled in the art, that décors is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data.

The invention is also described through embodiment examples.

EXAMPLE 1

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a décor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 30 g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20 g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70 μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30 g/m^2 of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20 g/m^2 of α-aluminium oxide particles with an average particle size of 70 μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate partial curing as a above. Each of the three layers had a surface weight of 20 g/m^2. The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10 μm. The first layer was applied to a surface weight of 10 g/m^2. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second layer of the topcoat lacquer was then applied and partly cured as described above. The wear layer was then provided with a surface structure by means of a surface structured roller. A third layer of the topcoat formulation was then applied on top of the structured wear layer. Also the third layer of top coat was applied to a surface weight of 10 g/m^2. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 7100 turns was obtained. An IP value of 7100 turns is fully sufficient for floor covering materials with medium to heavy traffic like hotel lobbies, hallways and the like.

EXAMPLE 2

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer. The build up of a wear layer was then initiated by applying 30 g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20

g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70 μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30 g/m^2 of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20 g/m^2 of α-aluminium oxide particles with an average particle size of 70 μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of 20 g/m^2. The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved. Also the uppermost of the three layers of lacquer was cured to a desired viscosity.

A second décor layer was then printed on top of the wear layer. The second décor layer, which was identical to the first décor closest to the core, was oriented and positioned so that it completely matched the first décor.

The build up of an upper wear layer was then initiated by applying 30 g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20 g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70 μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30 g/m^2 of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20 g/m^2 of α-aluminium oxide particles with an average particle size of 70 μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of 20 g/m^2. The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10 μm. The first layer was applied to a surface weight of 10 g/m^2. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second layer of the topcoat lacquer was then applied and partly cured as described above. The wear layer was then provided with a surface structure by means of a surface structured roller. A third layer of the topcoat formulation was then applied on top of the structured wear layer. Also the third layer of top coat was applied to a surface weight of 10 g/m^2. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 13500 turns was obtained. An IP value of 13500 turns is fully sufficient for floor covering materials with heavier traffic like airports, railway stations and the like. The second layer of décor and wear layer will add abrasion resistance without having obtained an unwanted hazy effect in the decor.

EXAMPLE 3

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on

top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 15 g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20 g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70 μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. One layer of UV-curing acrylic lacquer was then applied by roller coating and was partially cured as above. The layer had a surface weight of 40 g/m^2. The hard particles were embedded in the lacquer after the layer of lacquer was applied and a mainly plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10 μm. The first layer was applied to a surface weight of 10 g/m^2. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. The wear layer was then provided with a surface structure by means of a surface structured roller. A second, final layer of the topcoat formulation was then applied on top of the structured wear layer. Also the second layer of top coat was applied to a surface weight of 10 g/m^2. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 3100 turns was obtained. An IP value of 3100 turns is fully sufficient for floor covering materials with light traffic like bedrooms, living rooms and the like.

The invention is not limited to the embodiments shown as these can be varied in different ways within the scope of the invention. It is for example possible to use so-called overlay sheets of α-cellulose impregnated with thermosetting resin instead of acrylic lacquer in the process described in connection to process scheme 1 and in particular in the process described in connection to process scheme 2. These sheets of a-cellulose which are impregnated with melamine-formaldehyde resin is joined with the supporting core through heat and pressure, whereby the resin cures. The wear resistance may also in this embodiment be improved by adding hard particles in the range 50 nm–150 μm to the wear layer.

What is claimed is:

1. A process for the manufacturing of surface elements which surface elements comprise a decorative upper layer and a supporting core; said process comprising:

i) providing a supporting core with an upper side;

ii) providing the upper side of the supporting core with a décor, which décor is achieved by at last one of digitizing an actual archetype and at least partly creating said décor in a digital medium, which décor is positioned after a predetermined fixing point on the supporting core,

iii) protecting the upper side of the supporting core with an at least partly translucent, wear layer,

iv) enhancing the décor by accurately applying a surface structured matrix against the wear layer utilizing the predetermined fixing point to create a surface structure on the wear layer.

2. A process according to claim 1, wherein the décor is achieved by digitization of an actual archetype or by partly or completely being created in a digital media, which digitized décor is stored digitally in order to be used as a control function and original when printing the décor.

3. A process according to claim 2, wherein at least parts of the digitized décor is used, together with support programs for controlling further steps in the manufacturing procedure.

4. The process according to claim 3, wherein said further steps in the manufacturing procedure include at least one of identification marking, packaging, lacquering, surface embossing, storage logistics, delivery logistics, and assembly instructions.

5. The process according to claim 2, further comprising forming the décor by using controlled programs in combination with the digitized décor.

6. A process according to claim 1, wherein the supporting core is manufactured in the desired end user format and provided with edges intended for joining before applying the décor and the wear layer.

7. A process according to claim 1, wherein the supporting core is at least one of selected from the group consisting of a particle board and a fibre board.

8. A process according to claim 1, wherein at least parts of the supporting core comprise a polymer.

9. A process according to claim 8, wherein the supporting core comprises a polymer which also contains a filler in the form of a particle or fibre of organic or inorganic material.

10. The process according to claim 8, wherein said polymer comprises a polyurethane or a polyolefin.

11. The process according to claim 10, wherein said polyolefin is at least one selected from the group consisting of polyethylene, polypropylene and polybutylene.

12. A process according to claim 1, wherein the translucent wear layer consists of a UV curing or electron beam curing resin or lacquer.

13. A process according to claim 12, further comprising applying the wear layer in several steps with intermediate curing, of which the last applying comprising a curing step which is a complete curing while the intermediate curing step(s) are only partial curing step(s).

14. A process according to claim 12, wherein the wear layer also comprises hard particles with an average particle size in the range 50 nm–150 μm.

15. A process according to claim 14, wherein an upper portion of the wear layer is provided with hard particles in the range 50 nm–30 μm, while an inner portion of the wear layer is provided with hard particles in the range 10 μm–150 μm.

16. A process according to claim 15, wherein the hard particles are at least one selected from the group consisting of silicon oxide, silicon carbide, α-aluminium oxide and diamond.

17. The process according to claim 15, wherein the particles in the upper portion of the wear layer are in the range of 50 nm–10 μm, while the particles in the inner portion of the wear layer are in the range 30 μm–150 μm.

18. A process according to claim 14, wherein the hard particles are at least one selected from the group consisting of silicon oxide, silicon carbide and α-aluminium oxide.

19. The process according to claim 12, in which said resin or lacquer is one selected from the group consisting of acrylic, epoxy and maleimide.

20. A process according to claim 1, wherein the translucent wear layer consists of at least one sheet of α-cellulose impregnated with melamine-formaldehyde resin.

21. A process according to claim 20, wherein the wear layer is joined with the supporting core through heat and pressure, whereby the resin cures.

22. A process according to claim 20, wherein the wear layer also comprises hard particles with an average particle size in the range 50 nm–150 μm.

23. A process according to claim 22, wherein an upper portion of the wear layer is provided with hard particles in the range 50 nm–30 μm, while an inner portion of the wear layer is provided with hard particles in the range 10 μm–150 μm.

24. A process according to claim 23, wherein the hard particles are at least one selected from the group consisting of silicon oxide, silicon carbide, α-aluminium oxide and diamond.

25. A process according to claim 22, wherein the hard particles are at least one selected from the group consisting of silicon oxide, silicon carbide and α-aluminium oxide.

26. The process according to claim 23, wherein the particles in the upper portion of the wear layer are in the range of 50 nm–10 μm, while the particles in the inner portion of the wear layer are in the range of 30 μm–150 μm.

27. A process according to claim 1, wherein the décor on the surface elements is constituted by a number of décor segments with intermediate borders, which borders, on at least two opposite edges of a surface element coincide with borders on intended adjoining floor elements.

28. A process according to claim 1, wherein said at least one surface structured matrix forms at least one surface structure segment and is positioned on the decorative side of the surface element during the step in the process where the wear layer is applied on the surface element and is pressed towards the wear layer whereby the wear layer receives a surface with a structure that enhances the realistic impression of the décor.

29. A process according to claim 28, wherein at least one matrix forms the structured surface of at least one roller whereby the surface element is passed between the structured surface roller and a matching counter stay under continuous or discontinuous pressure between the rollers and the counter stay.

30. A process according to claim 29, wherein the roller equipped with two or more matrixes has a circumference adapted to a repetition distance in the variation of direction in the décor.

31. A process according to any of the claims 28, wherein a specially characteristic décor segments is visually simulated in the décor is stored as digital data, that said data is used for guiding automated engraving or pressing tools when providing said characteristic décor segments with a suitable surface structure, and that said engraving tool or pressing tool is synchronised via the predetermined fixing point on the surface element.

32. The process according to claim 31, wherein the specially characteristic décor segments are at least one selected from the group consisting of borderlines between simulated slabs, bars or blocks; knots, cracks, flaws and grain.

33. A process according to claim 1, further comprising providing at least two surface structured matrixes, which each matrix forms one surface structure segment, which segments are independent from each other concerning structure, and that said surface structure segments are intended to coincide with corresponding pattern segments in the decor, positioning said surface structured matrices on the decorative side of the surface element during the steps in the process where the wear layer is provided, and pressing the matrices toward the wear layer whereby the wear layer receives a surface structure corresponding to different pattern segments in the décor.

34. A process according to claim 33, wherein one or more matrixes forms the structured surface on one or more press belts, whereby the surface element is passed between the press belts and counter stays, with the decorative side facing the press belts, during continuous or discontinuous pressure between the press belts and counter stays.

35. A process according to claim 33, wherein at least one matrix forms the structured surface on at least one static moulds which is pressed towards the decorative surface of the surface element.

36. The process according to claim 1, wherein the protection of the upper side of the supporting core is achieved by at least one coating step selected from the group consisting of spray coating, roller coating, curtain coating, and immersion coating.

37. The process according to claim 1, wherein protecting of the upper side of the supporting core is achieved by providing at least one sheet of α-cellulose impregnated with thermosetting resin or lacquer as the at least partly translucent, wear layer.

38. The process according to claim 1, wherein the décor is formed by printing.

39. The process according to claim 1, wherein said core is formed of fiberboard.

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U.S. APPLICATION NO. 10/440,317
HANSSON ET AL
FILED MAY 19, 2003
TPP 31347DIV

A process for the manufacturing of surface elements.

The present invention relates to a process for the manufacturing of surface elements with a decorative upper surface of which the decorative elements have an considerably improved matching of the décor between adjacent surface elements.

Products clad with thermosetting laminate is common in many areas nowadays. They are mostly used where the demands on abrasion resistance are high, and furthermore where resistance to different chemicals and moisture is desired. As examples of such products floors, floor skirtings, table tops, work tops and wall panels can be mentioned.

The thermosetting laminate most often consist of a number of base sheets with a decor sheet placed closest to the surface. The decor sheet can be provided with a pattern by desire. Common patterns usually visualise different kinds of wood or mineral such as marble and granite.

One common pattern on floor elements is the rod pattern where two or more rows of rods of, for example wood, is simulated in the décor.

The traditional thermosetting laminate manufacturing includes a number of steps which will result in a random matching tolerance of up to ±5mm, which is considered to great. The steps included in the manufacturing of a laminate floor is; printing decor on a paper of α-cellulose, impregnating the decorative paper with melamine-formaldehyde resin, drying the decorative paper, laminating the decorative paper under heat and pressure together with similarly treated supporting papers, applying the decorative laminate on a carrier and finally sawing and milling the carrier to the desired format. All these steps in the manufacturing will cause a change in format on the decor paper. It will therefore be practically impossible to achieve a desired match of patterns between the elements of a without causing great amounts of wasted laminate. The thermosetting laminate is a rather costly part of a laminate floor.

It has, through the present invention, been made possible to overcome the above mentioned problems and a surface element with a decorative surface where the

decorative pattern between different surface elements is matching has been obtained. The invention relates to a process for the manufacturing of surface elements which comprises a decorative upper layer and a supporting core. The surface elements may be used as floor, wall or ceiling boards. The invention is characterised in that;

i) A supporting core with a desired format is manufactured and provided with an upper side and a lower side.

ii) The upper side of the supporting core is then provided with a décor, by for example printing. The décor is positioned after a predetermined fixing point on the supporting core.

iii) The upper side of the supporting core is then provided with a protecting, at least partly translucent, wear layer by for example spray coating, roller coating, curtain coating and immersion coating or by being provided with one or more sheets of α-cellulose impregnated with thermosetting resin or lacquer.

The décor is suitably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is stored digitally in order to be used as a control function and original, together with possible control programs, when printing the décor.

The décor may accordingly be obtained by making a high resolution or selected resolution digital picture of the desired décor. This is suitably made by means of a digital camera or scanner. The most common décor will of course be different kinds of wood and minerals like marble, as these probably will continue to be preferred surface decoration in home and public environments. It is, however, possible to depict anything that is visible. The digitised version of the décor is then edited to fit the size of the supporting core. It is also possible to rearrange the décor in many different ways, like changing colour tones, contrast, dividing the décor into smaller segments and adding other decorative elements. It is also possible to completely create the décor in a computer equipped for graphic design. It is possible to create a simulated décor so realistic that even a professional will have great problems in visually separating it from genuine material. This makes it possible to make for example floor boards with an almost perfect illusion of a rare kind of wood, like ebony or rose wood and still preserving trees under threat of extermination.

The digital décor is used together with guiding programs to control a printer. The printer may be of an electrostatic type or an ink-jet type printer. Most often the colours yellow, magenta, cyan and black will be sufficient for the printing process, but in some cases it might be advantageous to add white. Some colours are difficult to achieve using the colours yellow, magenta, cyan, black and white whereby the colours light magenta and light cyan may be added. It is also possible to add so called spot colours where specific colour tones are difficult to achieve or where only certain parts of the colour spectrum with intermixing shades is desired. The resolution needed is much depending on the décor that is to be simulated, but resolutions of 10 - 1500 dots per inch (dpi) is the practical range in which most décors will be printed. Under normal conditions a resolution of 300 - 800 dpi is sufficient when creating simulations of even very complex decorative patterns and still achieve a result that visually is very difficult to separate from the archetype without close and thorough inspection.

The digitally stored décor can also be used together with support programs when guiding other operations and procedures in the manufacturing process. Such steps in the operation may include procedures like identification marking, packaging, lacquering, surface embossing, storing and delivery logistics as well as assembly instructions.

It is advantageous to manufacture the supporting core in the desired end user format and to provide it with edges suited for joining before applying the décor and wear layer, since the amount of waste thereby is radically reduced. The décor matching tolerances will also be improved further by this procedure.

The main part of the supporting core is suitably constituted by a particle board or a fibre board. It is, however, possible to manufacture the core that at least partly consist of a polymer such as for example polyurethane or a polyolefin such as polyethylene, polypropylene or polybutene. A polymer based core can be achieved by being injection moulded or press moulded and can be given its shape by plastic moulding and does therefore not require any abrasive treatment. A polymer based core may except polymer also contain a filler in the form of a particle or fibre of organic or inorganic material, which besides the use a cost reducing material also

will be used to modify the mechanical characteristics of the core. As an example of such suitable fillers can be mentioned; cellulose or wood particles, straw, starch, glass, lime, talcum, stone powder and sand. The mechanical characteristics that may be changed is for example viscosity, thermal coefficient of expansion, elasticity, density, fire resistance, moisture absorption capacity, acoustic properties, thermal conductivity, flexural and shearing strength as well as softening temperature.

The upper surface, i.e. the surface that is to be provided with décor, is suitably surface treated before the printing. Such surface treatment will then incorporate at least one of the steps, ground coating and sanding. It is also possible to provide the surface with a structure that matches the décor that is to be applied.

The translucent wear layer is suitably constituted by a UV- or electron beam curing lacquer such as an acrylic, epoxy, or maleimide lacquer. The wear layer is suitably applied in several steps with intermediate curing where the last one is a complete curing while the earlier ones are only partial. It will hereby be possible to achieve thick and plane layers. The wear layer suitably includes hard particles with an average particle size in the range 50 nm - 150 µm. Larger particles, in the range 10 µm - 150 µm, preferably in the range 30 µm - 150 µm, is foremost used to achieve abrasion resistance while the smaller particles, in the range 50 nm - 30 µm, preferably 50 nm - 10 µm is used for achieving scratch resistance. The smaller particles is hereby used closest to the surface while the larger ones are distributed in the wear layer. The hard particles are suitably constituted of silicon carbide, silicon oxide, α-aluminium oxide and the like. The abrasion resistance is hereby increased substantially. Particles in the range 30 mm - 150 mm can for example be sprinkled on still wet lacquer so that they at, least partly, becomes embedded in finished wear layer. It is therefore suitable to apply the wear layer in several steps with intermediate sprinkling stations where particles are added to the surface. The wear layer can hereafter be cured. It is also possible to mix smaller particles, normally particle sizes under 30 µm with a standard lacquer. Larger particles may be added if a gelling agent or the like is present. A lacquer with smaller particles is suitably used as top layer coatings, closer to the upper surface. The scratch resistance can be improved by sprinkling very small particles in the range 50 nm - 1000 nm on the uppermost layer of lacquer. Also these, so called nano-particles, can be mixed with

lacquer, which with is applied in a thin layer with a high particle content. These nano-particles may besides silicon carbide, silicon oxide and α-aluminium oxide also be constituted of diamond.

According to one embodiment of the invention, the translucent wear layer is constituted of one or more sheets of α-cellulose which are impregnated with melamine-formaldehyde resin. These sheets are joined with the core under heat and pressure whereby the resin cures. It is, also in this embodiment, possible to add hard particles with an average particle size in the range 50 nm - 150 µm. Larger particles, in the range 10 µm - 150 µm, preferably 30 µm - 150 µm is foremost used to achieve abrasion resistance while the smaller of the particles, in the range 50 nm - 30 µm, preferably 50 nm - 10 µm, is used to achieve scratch resistance. The smaller particles is hereby used on, or very close to, the top surface while the larger particles may be distributed in the wear layer. Also here the particles advantageously are constituted of silicon carbide, silicon oxide, α-aluminium oxide, diamond or the like of which diamond, of cost reasons only is used as particles smaller than 1 µm. The sheets of α-cellulose is hereby suitably pressed together with the rest of the surface element in a continuos belt press with two steel belts. The pressure in the press is hereby suitably 5 - 100 Bar, preferably 20 - 80 Bar. The temperature is suitably in the range 140 - 200 °C, preferably 160 - 180 °C. It is also possible to utilise a discontinuous process where a number of surface elements can be pressed in a so called multiple-opening press at the same time. The pressure is then normally 20 - 150 Bar, preferably 70 - 120 Bar, while the temperature suitably is 120 - 180 °C, preferably 140 - 160 °C.

The décor on the surface elements is suitably constituted by a number of décor segments with intermediate borders, which borders, on at least two opposite edges coincides with intended, adjacent surface elements.

It is also desirable to provide the surface elements with a surface structure intended to increase the realism of the décor of the surface elements. This is suitably achieved by positioning at least one surface structured matrix, forming at least one surface structure segment on a corresponding décor segment or number of décor segments on

the decorated surface of the surface element in connection to the application of wear layer. This matrix is pressed towards the wear layer whereby this will receive a surface with structure that enhances the realism of the décor.

When simulating more complex patterns, like wood block chevron pattern or other décors with two or more divergent and oriented décors, it is suitable to use at least two structured matrixes which forms one structure segment each. The structure segment are here independent from each other in a structure point of view. The surface structure segments are intended to at least partly but preferably completely match the corresponding décor segments of the décor. The surface structure segments are accurately positioned on the décor side of the surface element in connection to the application of the wear layer, and is pressed onto this whereby the wear layer is provided with a surface structure where the orientation of the structure corresponds to the different directions in the décor.

One or more matrixes preferably forms the surface of one or more rollers. The surface element is then passed between the roller or rollers and counter stay rollers, with the décor side facing the structured rollers. The structured rollers are continuously or discontinuously pressed towards the décor surface of the surface element.

Rollers containing two or more matrixes, is suitably provided with a circumference adapted to the repetition frequency of change of direction in the décor.

It is also possible to apply the structure matrixes on the surface of a press belt. The surface element is then passed between the press belt and a press belt counter stay under continuous or discontinuous pressure between the structured press belt and the press belt counter stay.

It is, according to one alternative procedure, possible to have one or more matrixes form the structure surface of one or more static moulds which momentary is pressed towards the decorative side of the surface element.

According to one embodiment of the invention, particularly characteristic décor segments such as borderlines between simulated slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor, is stored as digital data. Said data is used for guiding automated engraving or pressing tools when providing said characteristic décor segments with a suitable surface structure,

and that said engraving tool or pressing tool is synchronised via the predetermined fixing point on the surface element.

The process described in the present application, for manufacturing surface elements is very advantageous from a logistic point of view since the number of steps when achieving a new décor is radically reduced. It is, according to the present invention possible to use digitally created or stored data for directly printing the décor on a surface element by using a ink-jet printer or a photo-static printer. The so-called set up time will thereby be very short, whereby even very special customer requirements may be met at a reasonable cost. It is according to the present invention possible to manufacture, for example, a world map in very large format, stretching over a great number of surface elements without any disrupting deviations in décor matching, to mainly the same cost as bulk produced surface elements. Since the décor may be handled digitally all the way to the point of being applied to the surface of the core, set up times will be practically non-existent while at the same time a high degree of automation will be practicable. It is also possible to automatically provide the surface elements with identification and orientation marking which would make the installation of complex décors, like world maps in the example above, much easier. This has so far been impossible.

The décor on the surface elements may be processed as follows;

i) A segmentation pattern is selected, the segmentation comprising at least two décor segments on each surface element. The shape, as seen from above, of the surface element is hereby selected from the group; triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal while the shape of the segments is selected from the group triangular, quadratic, rectangular, heptagonal, pentagonal, octagonal, circular, elliptical, perturbed and irregular.

ii) A segment décor is then selected for each segment. The segment décor is selected from the group; digitised and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor.

iii) Each selection is made on a terminal where the selections emanates from a data base and that the selection is visualised via the terminal.

The décor is preferably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is preferably stored digitally in order to be used as a control function and original, together with control programs and selection parameters, when printing the décor.

The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and support programs calculates an installation pattern. The installation pattern calculation is suitably also used for printing an assembly instruction. In order to visualise the selection the installation pattern calculation is possibly used for printing a miniaturised copy of the calculated installation with the selected pattern and décor. The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and that that support programs further calculates décor and segmentation pattern matching between the surface elements.

The selections is preferably also used, together with support programs for controlling further steps in the manufacturing procedure selected from the group; identification marking, positioning marking, packaging, lacquering, surface embossing, storing and delivery logistics.

An algorithm is suitably used for guiding the positioning of the décor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element. The control program is suitably used, together with décor data and selection parameters, for applying matching identification on the surface elements.

Surface elements manufactured as described above is suitably used as a floor covering material where the demands on stability and scratch and abrasion resistance is great. It is, according to the present invention, also possible to use the surface elements as wall and ceiling decorative material. It will however not be necessary to apply thick wear layer coatings in the latter cases as direct abrasion seldom occurs on such surfaces.

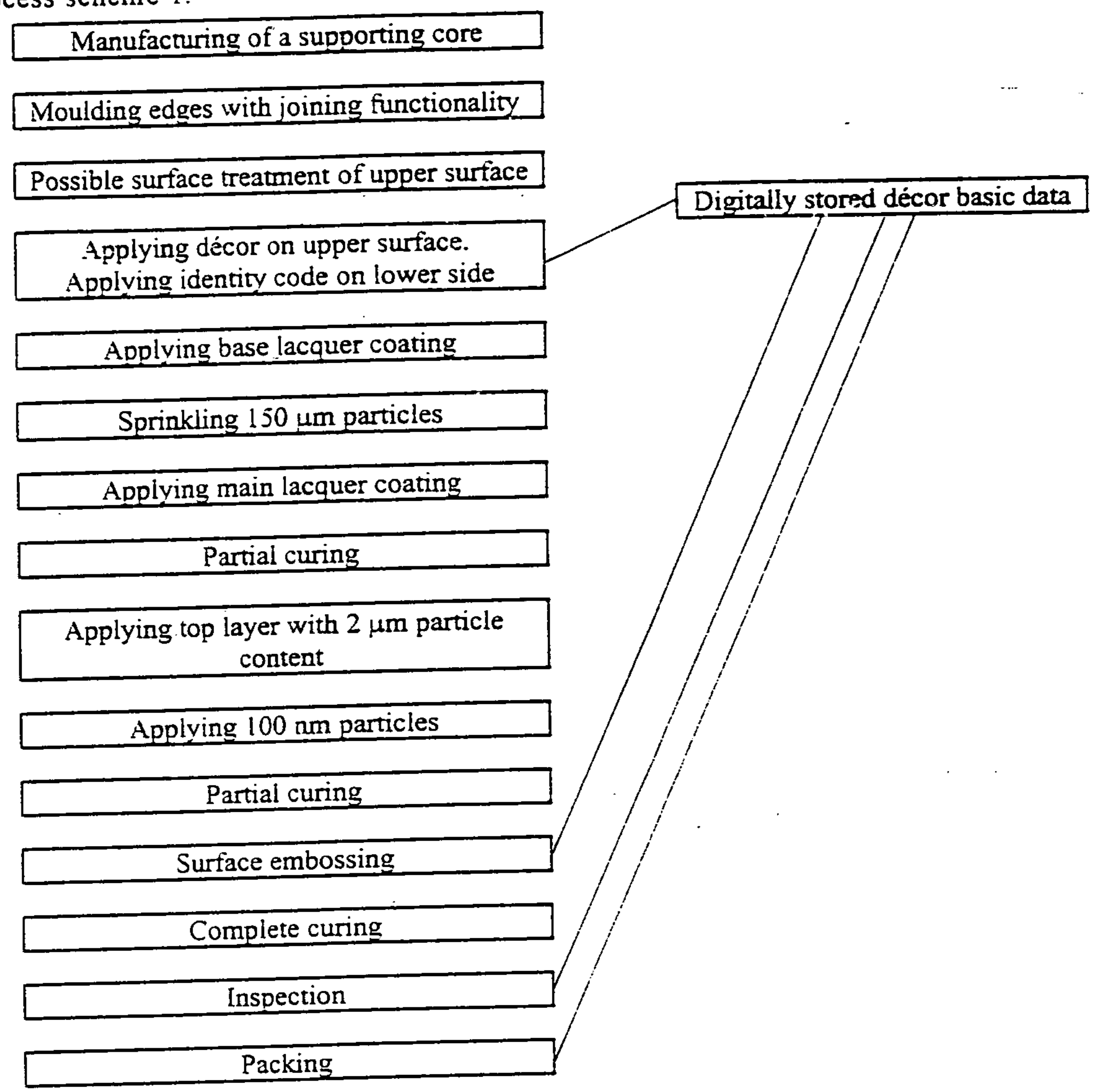
The invention is described further in connection to an enclosed figure, embodiment examples and schematic process descriptions showing different embodiments of the invention.

Accordingly, the figure shows parts of a surface element 1 which includes an upper decorative layer 2, edges 3 intended for joining, a lower side 4 and a supporting core 5. The process is initiated by manufacturing a supporting core 5 with a desired format and edges 3 intended for joining. The supporting core 5 is further provided with an upper side 1' suited for printing and a lower side 4. The upper side 1' of the supporting core 5 is then provided with a décor 2' by printing, utilising an ink-jet printer. The décor 2' is oriented after a predetermined fixing point on the supporting core 5. The upper side 1' of the supporting core 5 is then provided with a protecting translucent wear layer 2" through curtain coating. The supporting core 5 is constituted by particle board or fibre board. The translucent wear layer 2" is constituted by a UV-curing acrylic lacquer which is applied in several steps with intermediate curing, of which the last one is a complete curing while the earlier ones are only partial curing. The wear layer 2" also includes hard particles of α-aluminium oxide with an average particle size in the range 0,5µm - 150µm.

A surface structured matrix is positioned and pressed towards the décor side of the surface element 1 before the final curing of the acrylic lacquer whereby the surface of the wear layer 2" receives a surface structure 2''' which enhances the realism of the décor 2'.

It is also possible to utilise two or more surface structured matrixes, each forming a structure segment, between which the structure is independent, which will make it possible to simulate the surface structure of, for example, wood block chevron pattern décor.

Process scheme 1.



A supporting polymer and filler based core is manufactured in the desired format and is provided with an upper side, a lower side and edges provided with joining members, such as tongue and groove. The upper side of the supporting core is then sanded smooth after which a primer is applied. A décor is then applied on the upper side by means of a digital photo-static five colour printer. The colours are magenta, yellow, cyan, white and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length is selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a supporting core. The digital image of the wood blocks are then classified after wood grain pattern and colour so that a number of groups is achieved. The groups are; fair wood with even grain, dark wood with even grain, fair wood with knots and flaws, dark wood with knots and flaws, fair cross-grained wood and finally dark cross-grained wood. Each group contains five different block simulations. An algorithm is feed into a computer which is used for the guiding of the printing operation so that the simulated wood blocks is digitally placed in three longitudinal rows and mixed so that two similar wood blocks never is placed next to each other. The algorithm will also guide the position of the latitudinal borderlines between the simulated wood blocks so that they are unaligned with more than one block width between adjacent rows. It will also guide the latitudinal position of the borderlines so that it either aligns with the shorter edges of the supporting core or is unaligned with more than one block width. Another printer, also guided by the computer, is utilised for printing a running matching number on the lower side short side edges. The décor will hereby continue longitudinally over the surface elements and a perfect matching is obtained when the surface elements are placed in numerical order.

A basic layer of UV-curing acrylic lacquer is then applied by means of a rollers. Particles with an average particle size in the range 150 μm is then sprinkled onto the still wet basic layer, whereby the main layer of UV-curing acrylic lacquer is applied by spray coating. The two layers of lacquer are then partly cured using UV-light whereby the viscosity of the lacquer increases. A top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 2 μm, is then applied by means of a roller. Hard particles with an average size of 100 nm is then sprinkled on top of the wet top layer, whereby the lacquer is partly cured with UV-light so that the viscosity increases. The still soft lacquer is then provided with a structure in the form of narrow, small, elongated recesses, simulating the pores of the wood. This will increase the realism of the décor. This is achieved by alternate between two different structured roller per row of simulated wood blocks. The

structure of the rollers simulates even wood grain and cross-grained wood respectively. The rollers are alternately pressed towards the lacquered surface while it passes. The positioning of the rollers are guided via the digitally stored data used for printing the décor as well as the fixing point used there.

It is according to one alternative embodiment possible to utilise one or more static moulds with surface structure which momentary is pressed towards the décor side.

Especially characteristic décor segments such as borderlines between slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor, is suitably stored as digital data. This data is achieved by processing selected parts of the simulated wood blocks so that guiding data is achieved. Said data is then used for guiding an automated robot provided with an engraving tool or a press mould which provides the surface of the lacquer with a structure that matches said characteristic décor segments. The operation is also here synchronised via by the predetermined fixing point on the supporting core.

The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface elements may be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

The process above will make it possible to have a completely customer driven manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear to anyone skilled in the art, that a décor is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data. This will make it logistically possible to manufacture customer designed décors. Such a process is exemplified as follows;

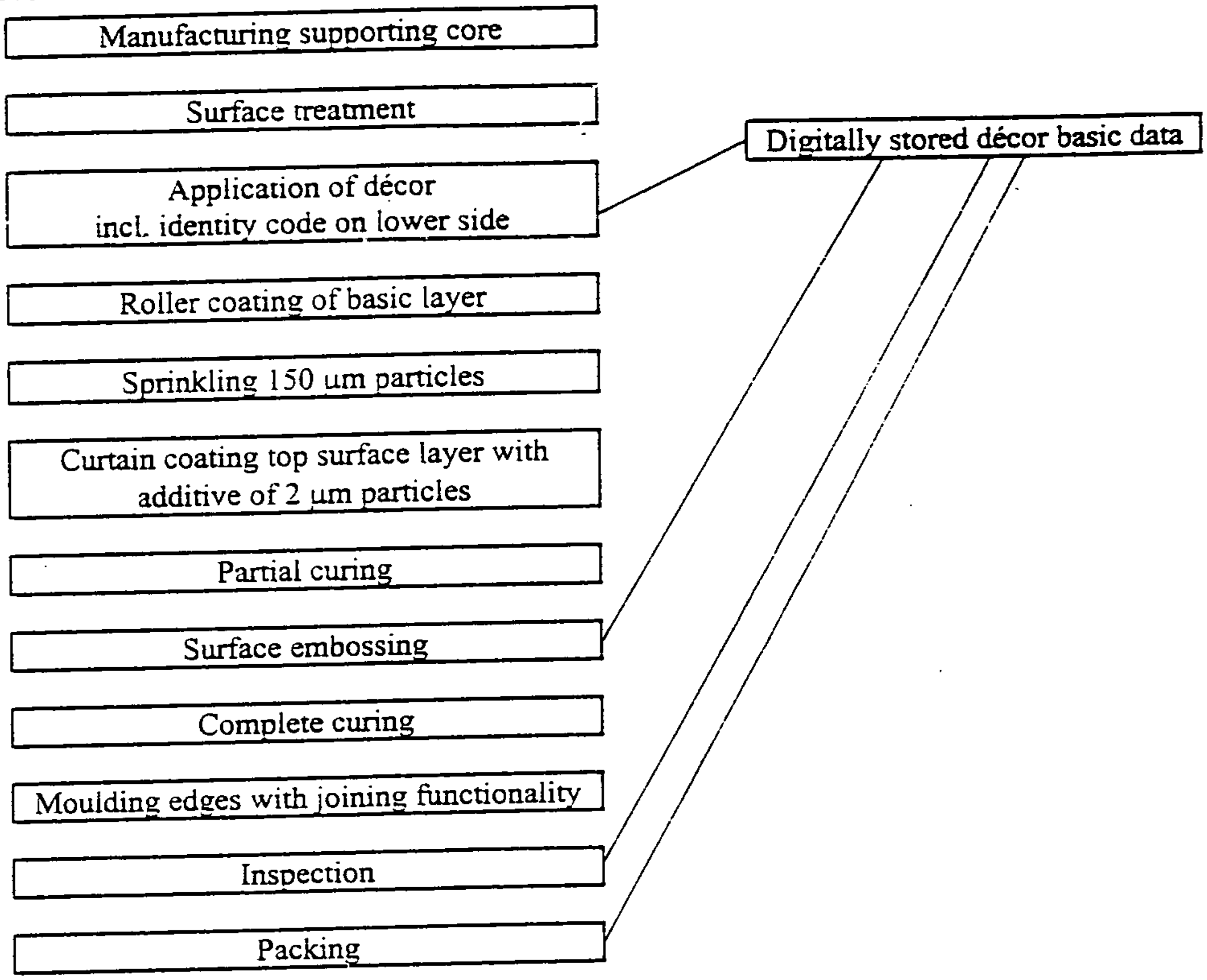
The customer utilises a database via Internet or at a local dealer. It is also possible for another operator utilise a database. The database contains samples and/or reduced resolution copies of a great variety of standard décors which can be combined after predetermined parameters.

The parameters may, for example, concern a single surface element where, for example, chevron pattern, diamond pattern and block pattern may be the choices of décor segmentation. It will here be possible to select a set of different simulations to randomly or by selected parameters fill the segments, for example, marble, birch and mahogany. The customer may also add an inlay from a design of his own which is digitised and processed, preferably automatically, to a desired format and resolution.

The parameters may alternatively include décor segments that requires the space of several surface elements, for example a map over the world. The parameters may here further include fading of the larger design to a surrounding décor, surrounding frame of other décor etc.

The customers enters the measurements of the surface that is to be covered by the surface elements. The customer then makes selections from the database and is able to see his selection as a completed surface, either on screen or by printing. The visualisation program used, is suitably also used for calculating installation pattern and presenting installation instructions with identification numbers on surface elements and where to cut the elements in order to make a perfect match. The surface elements may also be provided with removable matching lines on the decorative side making matching of décor between adjacent rows easier. The customer or dealer may then confirm his order via electronic mail where the pattern and décor is reduced to a code sequence and the order can be the direct input to the computer guiding the manufacturing process as described above. The customer and/or dealer data follows the manufacturing process all the way to packaging and a fully customer guided manufacturing process is achieved.

Process scheme 2



A supporting fibre board based core is manufactured in the desired format and is provided with an upper side, a lower side and edges. The upper side of the supporting core is then sanded smooth after which a white primer is applied. A décor is then applied on the upper side by means of a digital ink-jet four colour printer. The colours are magenta, yellow, cyan and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length are selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a finished surface element. The digital

image of the wood blocks are then joined digitally to form a rectangular surface of a specified size, for example, 200 x 1200 mm. A selected amount of such combinations of different blocks are designed as described above so that a number of slightly different rectangular surfaces is achieved. The printer, or preferably a set of printers are positioned so that a desired number of rectangular décor surfaces with a specified intermediate distance is printed on the supporting core. The intermediate distance between the rectangular surfaces is the distance needed for parting and moulding of edges. The décor printer or printers are also used for printing fixing points at predetermined positions. Another printer, also guided by the computer, is utilised for printing an identity code on the lower side of each intended finished surface element.

A basic layer of UV-curing acrylic lacquer is then applied by means of rollers. Particles with an average particle size in the range 75 µm is then sprinkled onto the still wet basic layer, whereby a top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 2 µm, is applied by means of a roller. Hard particles with an average size of 100 nm is then sprinkled on top of the wet top layer, whereby the lacquer is partly cured with UV-light so that the viscosity increases. The still soft lacquer is then provided with a structure in the form of narrow, small, elongated recesses, simulating the pores of the wood. This will increase the realism of the décor. This is achieved by pressing rollers towards the lacquered surface while it passes. The positioning of the rollers are guided via the digitally stored data used for printing the décor, as well as the fixing point used there when more complex and completely matching surface structures as described together with process scheme 1 is desired.

The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface element is cut into the predetermined formats which are provided with edges with joining functionality are moulded by milling. The cutting and edge moulding process is positioned from fixing point printed close to the décor. The surface elements may then be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

It is, according to an alternative procedure in the process, possible to cut and mould the edges at an earlier stage in the process. It is suitable to apply and cure a protecting layer of lacquer on top of the printed décor followed by cutting and

moulding of the edges. The remaining and main part of the wear layer is then applied as described in connection to process scheme 1 or 2 above.

The process above will make it possible to have a customer initiated manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear anyone skilled in the art, that décors is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data.

The invention is also described through embodiment examples.

EXAMPLE 1.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 30g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30g/m^2 of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20g/m^2 of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate partial curing as a above. Each of the three layers had a surface weight of 20g/m^2. The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly

cured, layers. The topcoat lacquer contained 10% by weight of hard particies of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of $10 g/m^2$. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second layer of the topcoat lacquer was then applied and partly cured as described above. The wear layer was then provided with a surface structure by means of a surface structured roller. A third layer of the topcoat formulation was then applied on top of the structured wear layer. Also the third layer of top coat was applied to a surface weight of $10 g/m^2$. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 7100 turns was obtained. An IP value of 7100 turns is fully sufficient for floor covering materials with medium to heavy traffic like hotel lobbies, hallways and the like.

EXAMPLE 2.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer. The build up of a wear layer was then initiated by applying $30 g/m^2$ of UV-curing acrylic lacquer by means of roller coating. $20 g/m^2$ of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another $30 g/m^2$ of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another $20 g/m^2$ of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of $20 g/m^2$. The hard particles were completely embedded in the lacquer after

the three layers were applied and a plane upper wear layer surface was achieved. Also the uppermost of the three layers of lacquer was cured to a desired viscosity.

A second décor layer was then printed on top of the wear layer. The second décor layer, which was identical to the first décor closest to the core, was oriented and positioned so that it completely matched the first décor.

The build up of an upper wear layer was then initiated by applying $30g/m^2$ of UV-curing acrylic lacquer by means of roller coating. $20g/m^2$ of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another $30g/m^2$ of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another $20g/m^2$ of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of $20g/m^2$. The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of $10g/m^2$. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second layer of the topcoat lacquer was then applied and partly cured as described above. The wear layer was then provided with a surface structure by means of a surface structured roller. A third layer of the topcoat formulation was then applied on top of the structured wear layer. Also the third layer of top coat was applied to a surface weight of $10g/m^2$. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 13500 turns was obtained. An IP value of 13500 turns is fully sufficient for floor covering materials with heavier traffic like airports, railway stations and the like. The second layer of décor and wear layer will add abrasion resistance without having obtained an unwanted hazy effect in the décor.

EXAMPLE 3.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 15g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70µm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. One layer of UV-curing acrylic lacquer was then applied by roller coating and was partially cured as above. The layer had a surface weight of 40g/m^2. The hard particles were embedded in the lacquer after the layer of lacquer was applied and a mainly plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10µm. The first layer was applied to a surface weight of 10g/m^2. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. The wear layer was then provided with a surface structure by means of a surface structured roller. A second, final layer of the topcoat formulation was then applied on top of the structured wear layer. Also the second layer of top coat was applied to a surface weight of 10g/m^2. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 3100 turns was obtained. An IP value of 3100 turns is fully

sufficient for floor covering materials with light traffic like bedrooms, living rooms and the like.

The invention is not limited to the embodiments shown as these can be varied in different ways within the scope of the invention. It is for example possible to use so-called overlay sheets of α-cellulose impregnated with thermosetting resin instead of acrylic lacquer in the process described in connection to process scheme 1 and in particular in the process described in connection to process scheme 2. These sheets of a-cellulose which are impregnated with melamine-formaldehyde resin is joined with the supporting core through heat and pressure, whereby the resin cures. The wear resistance may also in this embodiment be improved by adding hard particles in the range 50 nm - 150μm to the wear layer.

CLAIMS

1. A process for the manufacturing of surface elements (1) which comprises a decorative upper layer (2) and a supporting core (5), characterised in that;
   i) a supporting core (5) with a desired format is manufactured and provided with an upper side (1') and a lower side (4), whereby
   ii) the upper side (1') of the supporting core (5) is provided with a décor, by for example printing, which décor (2') is positioned after a predetermined fixed point on the supporting core (5), whereby
   iii) the upper side (1') of the supporting core (5) is provided with a protecting, at least partly translucent, wear layer (2") by for example spray coating, roller coating, curtain coating and immersion coating or by being provided with one or more sheets of α-cellulose impregnated with thermosetting resin or lacquer.

2. A process according to claim 1, characterised in that the décor is achieved by digitisation of an actual archetype or by partly or completely being created in a digital media, which digitised décor (2') is stored digitally in order to be used as a control function and original, together with possible control programs, when printing the décor (2').

3. A process according to claim 2, characterised in that at least parts of the digital décor (2') is used, together with support programs for controlling further steps in the manufacturing procedure such as identification marking, packaging, lacquering, surface embossing, storing and delivery logistics as well as assembly instructions.

4. A process according to any of the claims 1 - 3, characterised in that the supporting core (5) is manufactured in the desired end user format and provided with edges (3) intended for joining before applying décor and wear layer.

5. A process according to any of the claims 1 - 4, characterised in that the main part of the supporting core (5) is constituted by a particle board or a fibre board.

6. A process according to any of the claims 1 - 4, characterised in that at least parts of the supporting core (5) is constituted of a polymer such as for example polyurethane or a polyolefin such as polyethylene, polypropylene or polybutene.

7. A process according to claim 6, characterised in that the supporting core (5) except polymer also contains a filler in the form of a particle or fibre of organic or inorganic material.

8. A process according to any of the claims 1 - 7, characterised in that the translucent wear layer (2") is constituted of a UV curing or electron beam curing resin or lacquer such as for example acrylic, epoxy or maleimide lacquer.

9. A process according to claim 8, characterised in that the wear layer (2") is applied in several steps with intermediate curing, of which the last is a a complete curing while the earlier are only partial.

10. A process according to claim 8 or 9, characterised in that the wear layer (2") also comprises hard particles with an average particle size in the range 50nm - 150μm.

11. A process according to claim 10, character ised in that the upper portion of the wear layer (2") is provided with hard particles in the range 50nm - 30μm, preferably 50nm - 10μm while the inner portion of the wear layer (2") is provided with hard particles in the range 10 μm - 150 μm, preferably 30 μm - 150 μm.

12. A process according to claim 10, characterised in that the hard particles is constituted by silicon oxide, silicon carbide, α-aluminium oxide or the like.

13. A process according to claim 11, characterised in that the hard particles is constituted by silicon oxide, silicon carbide, α-aluminium oxide, diamond or the like.

14. A process according to any of the claims 1 - 7, characterised in that the translucent wear layer (2") is constituted by one or more sheets of α-cellulose impregnated with melamine-formaldehyde resin.

15. A process according to claim 14, characterised in that the wear layer (2") is joined with the supporting core (5) through heat and pressure, whereby the resin cures.

16. A process according to claim 14 or 15, characterised in that the wear layer (2") also comprises hard particles with an average particle size in the range 50nm - 150µm.

17. A process according to claim 16, character ised in that the upper portion of the wear layer (2") is provided with hard particles in the range 50nm - 30µm, preferably 50nm - 10µm while the inner portion of the wear layer (2") is provided with hard particles in the range 10 µm - 150 µm, preferably 30 µm - 150 µm.

18. A process according to claim 10, characterised in that the hard particles is constituted by silicon oxide, silicon carbide, α-aluminium oxide or the like.

19. A process according to claim 11, characterised in that the hard particles is constituted by silicon oxide, silicon carbide, α-aluminium oxide, diamond or the like.

20. A process according to any of the claims 1 - 19, characterised in that the décor on the surface elements (1) is constituted by a number of décor segments with intermediate borders, which borders, on at least two opposite edges of a surface element (1) coincides with borders on intended adjoining floor elements (1).

21. A process according to any of the claims 1 - 20, characterised in that at least one surface structured matrix which forms at least one surface structure segment is positioned on the decorative side of the surface element (1) during the step in the process where the wear layer (2") is applied on the surface element (1) and is pressed towards this whereby the wear layer (2") receives a surface with structure that enhances the realistic impression of the décor (2').

22. A process according to any of the claims 2 - 21, characterised in that two or more surface structured matrixes, which each forms one surface structure segment, which segments are independent from each other concerning structure, and that said surface structure segments are intended to mainly, preferably completely coincide with corresponding pattern segments in the décor, is thoroughly positioned on the decorative side of the surface element (1) during the steps in the process where the wear layer (2") is provided with a wear layer (2"), and pressed toward this whereby the wear layer (2") receives a surface structure (2"') corresponding to the different pattern segments in the décor.

23. A process according to claim 21 or 22, characterised in that one or more matrixes forms the structured surface of one or more rollers whereby the surface element (1) is passed between the structured roller and matching counter stay under continuos or discontinuous pressure between the rollers and the counter stays.

24. A process according to claim 23, characterised in that rollers equipped with two or more matrixes has a circumference adapted to repetition distance in the variation of direction in the décor.

25. A process according to claim 22, characterised in that one or more matrixes forms the structured surface on one or more press belts, whereby the surface element (1) is passed between the press belts and counter stays, with the decorative side facing the press belts, during continuous or discontinuous pressure between the press belts and counter stays.

26. A process according to claim 22, characterised in that one or more matrixes forms the structured surface on one or more static moulds which momentary and static is pressed towards the decorative surface of the surface element (1).

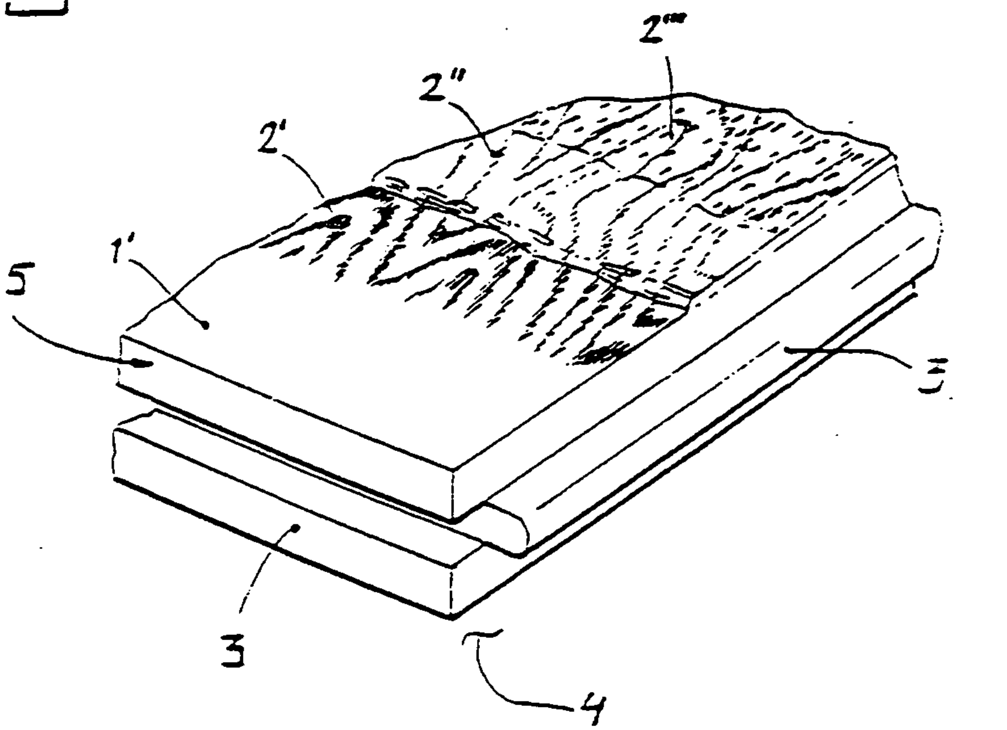
27. A process according to any of the claims 21 - 26, c h a r a c t e r i s e d in that specially characteristic décor segments such as borderlines between simulated slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor (2'), is stored as digital data, that said data is used for guiding automated engraving or pressing tools when providing said characteristic décor segments with a suitable surface structure, and that said engraving tool or pressing tool is synchronised via the predetermined fixing point on the surface element (1).

28. A surface element (1) manufactured according to any of the claims 1 - 27, c h a r a c t e r i s e d in that they form floor elements intended to be joined to become a floor covering material, wall elements intended to be joined to become a wall covering material or ceiling elements intended to be joined to become a ceiling material.

ABSTRACTS:

A process for the manufacturing of surface elements (1) which comprises a decorative upper layer (2) and a supporting core (5). A supporting core (5) with a desired format is manufactured and provided with an upper side (1') and a lower side (4). The upper side (1') of the supporting core (5) is provided with a décor, by for example printing, which décor (2') is positioned after a predetermined fixed point on the supporting core (5). The upper side (1') of the supporting core (5) is provided with a protecting, at least partly translucent, wear layer (2") by for example spray coating, roller coating, curtain coating and immersion coating or by being provided with one or more sheets of α-cellulose impregnated with thermosetting resin or lacquer.

Fig.



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U.S. APPLICATION NO. 09/964,838
NILSSON ET AL
FILED SEPTEMBER 28, 2001
TPP 31424

A process for the manufacture of surface elements.

The present invention relates to a process for the manufacture of decorative surface elements with a surface structure matching the decor of the upper surface.

Products coated with simulated versions of materials such as wood and marble are frequent today. They are foremost used where a less expensive material is desired, but also where resistance towards abrasion, indentation and different chemicals and moisture is required. As an example of such products floors, floor beadings, table tops, work tops and wall panels can be mentioned.

As an example of an existing product can be mentioned the thermosetting laminate which mostly consists of a number of base sheets with a decor sheet placed closest to the surface. The decor sheet can be provided with a desired decor or pattern. Frequently used patterns usually represent the image of different kinds of wood or minerals such as marble or granite. The surface of the laminate can, at the laminating procedure, be provided with a structure, which will make the decor more realistic. Press plates with structure or structure foils are here frequently used during the pressing of the laminate. A negative reproduction of the structure in the press plate or the foil will be embossed into the laminate surface during the laminating procedure.

The structure suitably represents features characteristic for the pattern the decor represents. The structure can be made coarse to simulate for example rough planed stone, or smooth with randomly placed pits and micro cracks to simulate polished marble. When the surface of wood is simulated the surface is provided with randomly placed thin oblong indentations which imitate pores.

It has for a long time been a great need to be able to manufacture simulated materials where a lacquer is used as a top coat on a decor. The only way, so far, to achieve a surface structure in lacquer is casting or abrasive moulding which both are time consuming and expensive processes.

According to the present invention the above mentioned needs have been met and a surface element with a decorative surface with a surface structure has been achieved. The invention relates to a process for the manufacture of a decorative surface element. The element comprises a base layer, a decor and a wear layer of a UV or electron beam curing lacquer. The invention is characterised in that one or more structured surfaces forming embossing surfaces of or more rollers or moulds are positioned on top of the decorative lacquered surface, possibly after having cured the lacquer to a desired viscosity, and are continuously or discontinuously pressed on to this. The lacquer will hereby be provided with a surface structure which enhances the decorative effect of the decor. The wear layer is then completely cured. The lacquer preferably consists of a UV-curing or electron beam curing acrylic or maleamide lacquer. The wear layer is preferably applied in several steps with intermediate partial curing. The wear layer preferably also includes hard particles with an average particle size in the range 50nm - 150μm. The base layer may suitably consist of a particle board or a fibre board but may also be made of a material which mainly consist of a polymer such as polyurethane.

In order to make the structuring process run smoother, the surface element preferably contains a layer which is elastic at least before the complete curing. The elastic layer is selected from the group consisting of; the base layer, a primer layer, the decor layer and the wear layer.

The structuring process will most often result in undesirable raised sections in the surface. These sections can be planed out by pressing one or more glazing rollers towards the surface structured wear layer before the complete curing stage.

The structured rollers are preferably heated to a surface temperature above 40°C, preferably in the range 50°C - 150°C. This will minimise the risk for forming of cracks. The glazing rollers are preferably also heated to a surface temperature above 30°C, preferably in the range 35°C - 100°C for the same reason.

According to an alternative embodiment of the invention the structuring is achieved by means of a mould. The structured surface of the mould is heated to a surface temperature above 40°C, preferably in the range 50°C - 150°C. The

pressure exercised by the structured mould surface is 50 - 200 Bar, preferably 65 - 100 Bar.

The glazing process will result in a surface which is easier to clean. It is also possible to achieve such a surface by applying a thin top coat on top of the structured wear layer. Such a thin top coat may of course be applied on top of the structured wear layer after the glazing stage as well. A thin top coat may advantageously also be applied on top of the structured wear layer before the glazing stage. The top coat is then partially cured before the glazing. The top coat is suitably comprised of acrylic or maleamide lacquer and does possibly have an additive in the form of hard particles with an average particle size in the range 50nm - 10µm.

Each structured roller is provided with a counter stay roller between which the surface element is passed. Each glazing roller is preferably also provided with a counter stay roller between which the surface element is passed. The surface element has a thickness T and the distance between each structured roller and corresponding counter stay is preferably set in the range T minus 0.5mm to 1.2mm, preferably 0.7mm - 0.9mm. The pressure between each structured roller and its corresponding counter stay is then 50 - 200 Bar, preferably 65 - 100 Bar. The surface element has a thickness T and that the distance between each glazing roller and corresponding counter stay is set in the range T minus 0.7mm - 1.2mm, preferably 0.7mm - 0.9mm. The pressure between each glazing roller and its corresponding counter stay is suitably in the range 0.1 - 10 Bar, preferably 0.5 - 5 Bar.

The hard particles added to the lacquer consists of for example silicon oxide, α-aluminium oxide or silicon carbide. According to one embodiment of the invention the main part of the hard particles consists of for example silicon oxide, α-aluminium oxide or silicon carbide while a smaller amount of the hard particles consist of diamond. The hard particles consisting of diamond is then in the average particle size range 50nm - 2µm and is placed close to the upper surface of the wear layer.

The rollers may, when more than one structured roller is used, be provided with different surface structures. This will make it possible to achieve a surface structure with a variation that corresponds to the visible decor.

CLAIMS

1. A process for the manufacture of a decorative surface element, which element comprises a base layer, a decor and a wear layer of a UV or electron beam curing lacquer, c h a r a c t e r i s e d in that one or more structured surfaces, forming embossing surfaces of one or more rollers or moulds, are positioned on top of the decorative lacquered surface, possibly after having cured the lacquer to a desired viscosity, and are continuously or discontinuously pressed on to this, whereby the lacquer will be provided with a surface structure which enhances the decorative effect of the decor, whereupon the wear layer is completely cured.

2. A process according to claim 1, c h a r a c t e r i s e d in that the lacquer consists of an acrylic or a maleamide lacquer.

3. A process according to claim 1 or 2, c h a r a c t e r i s e d in that the wear layer is applied in several steps with intermediate partial curing.

4. A process according to any of the claims 1 - 3, c h a r a c t e r i s e d in that the wear layer includes hard particles with an average particle size in the range 50nm - 150µm.

5. A process according to claim 1, c h a r a c t e r i s e d in that the base layer consists of a particle board or a fibre board.

6. A process according to claim 1, c h a r a c t e r i s e d in that the base layer consists mainly of a polymer such as polyurethane.

7. A process according to any of the claims 1 - 6, c h a r a c t e r i s e d in that the surface element contains a layer which is elastic at least before the complete curing, the elastic layer being selected from the group; the base layer, a primer layer, the decor layer and the wear layer.

8. A process according to any of the claims 1 - 7, c h a r a c t e r i s e d in that one or more glazing rollers is pressed towards the surface structured wear layer before the complete curing stage.

9. A process according to any of the claims 1 - 8, characterised in that the structured rollers are heated to a surface temperature above 40°C, preferably in the range 50°C - 150°C.

10. A process according to any of the claims 1 - 8, characterised in that the glazing rollers are heated to a surface temperature above 30°C , preferably in the range 35°C - 100°C.

11. A process according to any of the claims 1 - 7 or 9, characterised in that a thin top coat is applied on top of the structured wear layer.

12. A process according to any of the claims 8 - 10, characterised in that a thin top coat is applied on top of the structured wear layer after the glazing stage.

13. A process according to any of the claims 8 - 10, characterised in that a thin top coat is applied on top of the structured wear layer before the glazing stage and that the top coat is partially cured before the glazing.

14. A process according to any of the claims 11 - 13, characterised in that the top coat is comprised of acrylic or maleamide lacquer and possibly an additive in the form of hard particles with an average particle size in the range 50nm - 10µm.

15. A process according to any of the claims 1 - 14, characterised in that each structured roller is provided with a counter stay roller between which the surface element is passed.

16. A process according to any of the claims 8 - 15, characterised in that each glazing roller is provided with a counter stay roller between which the surface element is passed.

17. A process according to claim 15, characterised in that the surface element has a thickness T and that the distance between each structured roller and corresponding counter stay is set in the range T minus 0.5mm - 1.2mm, preferably 0.7mm - 0.9mm.

18. A process according to claim 17, characterised in that the pressure between each structured roller and its corresponding counter stay is 50 - 200 Bar, preferably 65 - 100 Bar.

19. A process according to claim 16, characterised in that the surface element has a thickness T and that the distance between each glazing roller and corresponding counter stay is set in the range T minus 0.7mm - 1.2mm, preferably 0.7mm - 0.9mm.

20. A process according to claim 19, characterised in that the pressure between each glazing roller and its corresponding counter stay is 0.1 - 10 Bar, preferably 0.5 - 5 Bar.

21. A process according to any of the claims 1 - 8, characterised in that the structured surface of the mould is heated to a surface temperature above 40°C, preferably in the range 50°C - 150°C.

22. A process according to claim 21, characterised in that the pressure exercised by the structured mould surface is 50 - 200 Bar, preferably 65 - 100 Bar.

23. A process according to any of the claims 4 - 22, characterised in that the hard particles consists of for example silicon oxide, α-aluminium oxide or silicon carbide.

24. A process according to any of the claims 4 - 22, characterised in that the main part of the hard particles consists of for example silicon oxide, α-aluminium oxide or silicon carbide while a smaller amount of the hard particles consist of diamond.

25. A process according to claim 24, characterised in that the hard particles consisting of diamond is in the average particle size range 50nm - 2µm and is placed close to the upper surface of the wear layer.

ABSTRACTS:

A process for the manufacture of a decorative surface element, which element comprises a base layer, a decor and a wear layer of a UV or electron beam curing lacquer. One or more structured surfaces, forming embossing surfaces of one or more rollers or moulds, are positioned on top of the decorative lacquered surface, possibly after having cured the lacquer to a desired viscosity, and are continuously or discontinuously pressed on to this. The lacquer will be provided with a surface structure which enhances the decorative effect of the decor. The wear layer is then completely cured.

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HANSSON ET AL
FILED NOVEMBER 24, 2000
TPP 31352

A process for the manufacturing of surface elements with a structured upper surface.

The present invention relates to a process for the manufacture of decorative surface elements with a surface structure matching the decor of the upper surface.

Products coated with simulated versions of materials such as wood and marble are frequent today. They are foremost used where a less expensive material is desired, but also where resistance towards abrasion, indentation and different chemicals and moisture is required. As an example of such products floors, floor beadings, table tops, work tops and wall panels can be mentioned.

As an example of an existing product can be mentioned the thermosetting laminate which mostly consists of a number of base sheets with a decor sheet placed closest to the surface. The decor sheet can be provided with a desired decor or pattern. Frequently used patterns usually represent the image of different kinds of wood or minerals such as marble or granite. The surface of the laminate can, at the laminating procedure, be provided with a structure, which will make the decor more realistic. Press plates with structure or structure foils are here frequently used during the pressing of the laminate. A negative reproduction of the structure in the press plate or the foil will be embossed into the laminate surface during the laminating procedure.

The structure suitably represents features characteristic for the pattern the decor represents. The structure can be made coarse to simulate for example rough planed stone, or smooth with randomly placed pits and micro cracks to simulate polished marble. When the surface of wood is simulated the surface is provided with randomly placed thin oblong indentations which imitate pores.

It has for a long time been a great need to be able to manufacture simulated materials where a lacquer is used as a top coat on a decor. The only way, so far, to

achieve a surface structure in lacquer is casting or abrasive moulding which both are time consuming and expensive processes.

The invention relates to a process for the manufacturing of a decorative surface element. The element comprises a base layer, a decor and a wear layer of a UV or electron beam curing lacquer.

The design of the décor can be achieved by utilising the process steps below;

i) A segmentation pattern is selected, the segmentation comprising at least two décor segments on each surface element. The shape, as seen from above, of the surface element is hereby selected from the group; triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal while the shape of the segments is selected from the group triangular, quadratic, rectangular, heptagonal, pentagonal, octagonal, circular, elliptical, perturbed and irregular.

ii) A segment décor is then selected for each segment. The segment décor is selected from the group; digitised and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor.

iii) Each selection is made on a terminal where the selections emanates from a data base and that the selection is visualised via the terminal.

The décor is preferably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is preferably stored digitally in order to be used as a control function and original, together with control programs and selection parameters, when printing the décor.

The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and support programs calculates an installation pattern. The installation pattern calculation is suitably also used for printing an assembly instruction. In order to visualise the selection the installation pattern calculation is possibly used for printing a miniaturised copy of the calculated installation with the selected pattern and décor. The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and that that support programs further calculates décor and segmentation pattern matching between the surface elements.

The selections is preferably also used, together with support programs for controlling further steps in the manufacturing procedure selected from the group; identification marking, positioning marking, packaging, lacquering, surface embossing, storing and delivery logistics.
An algorithm is suitably used for guiding the positioning of the décor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element. The control program is suitably used, together with décor data and selection parameters, for applying matching identification on the surface elements.

It is also possible to manufacture a designed larger surface with décor segments larger than a surface element by utilising the process as described below;

i) A selected main décor is entered via a terminal, the selected décor emanating from a group consisting of; an archetype digitised via digital camera or scanner and a digitised décor from a database.

ii) The dimensions of the surface to be covered by surface elements and the desired dimension of the décor is then entered into the terminal. Support programs are used for calculating the segmentation of the main décor to cover more than one surface element.

iii) The result of the selections and calculations is finally visualised via the terminal.

The digitised main décor is stored digitally in order to be used as a control function and original, together with control programs and selection parameters, when printing the décor.

It is, in order to enhance the decorative effect of some decor possible to select a surrounding décor. A décor effect in the border between the main décor and the surrounding décor is suitably also selected, the selection being made from the group; fading, sharp edge, sharp edge with shadow effect, jagged edge, jagged edge with shadow and surrounding inlay of other décor.
The surrounding décor is preferably processed as follows;

i) A segmentation pattern for the surrounding décor is selected. The segmentation

comprising at least two décor segments on each surface element. The shape, as seen from above, of the surface element is preferably selected from the group; triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal. The shape of the surface elements with surrounding décor and the shape of the surface elements which, of course, is selected so that they can be joined with each other. The shape of the segments is selected from the group triangular, quadratic, rectangular, heptagonal, pentagonal, octagonal, circular, elliptical, perturbed and irregular.

ii) A segment décor is then selected for each segment. The segment décor is selected from the group; digitised and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor.

iii) Each selection is made on a terminal where the selections emanates from a data base. The selection is visualised via the terminal.

A décor effect in the border between the main décor and the surrounding décor is suitably selected. The selection is preferably made from the group; fading, sharp edge, sharp edge with shadow effect, jagged edge, jagged edge with shadow and surrounding inlay of other décor. Also this selection is made on the terminal.

The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and support programs calculates an installation pattern. The installation pattern calculation is preferably used for printing an assembly instruction. The installation pattern calculation is according to one embodiment of the invention used for printing a miniaturised copy of the calculated installation with the selected pattern and décor. This print out may serve as an evaluation copy of the design before making decisions regarding the manufacturing.

The dimensions of the surface to be covered by surface elements is entered into the terminal. Support programs further calculates décor and segmentation pattern matching between the surface elements. The selections is preferably used, together with support programs for controlling further steps in the manufacturing procedure selected from the group; identification marking, positioning marking, packaging,

lacquering, surface embossing, storing and delivery logistics. An algorithm is preferably used for guiding the positioning of the décor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element. The control program is then preferably used together with décor data and selection parameters for applying matching identification on the surface elements.

The surface elements may be used as floor, wall or ceiling boards. The surface elements are suitably manufactured through the following process;

i) A supporting core with a desired format is manufactured and provided with an upper side and a lower side.

ii) The upper side of the supporting core is then provided with a décor, by for example printing. The décor is positioned after a predetermined fixing point on the supporting core.

iii) The upper side of the supporting core is then provided with a protecting, at least partly translucent, wear layer by for example spray coating, roller coating, curtain coating and immersion coating or by being provided with one or more sheets of α-cellulose impregnated with thermosetting resin or lacquer.

The décor is suitably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is stored digitally in order to be used as a control function and original, together with possible control programs, when printing the décor.

The décor may accordingly be obtained by making a high resolution or selected resolution digital picture of the desired décor. This is suitably made by means of a digital camera or scanner. The most common décor will of course be different kinds of wood and minerals like marble, as these probably will continue to be preferred surface decoration in home and public environments. It is, however, possible to depict anything that is visible. The digitised version of the décor is then edited to fit the size of the supporting core. It is also possible to rearrange the décor in many different ways, like changing colour tones, contrast, dividing the décor into smaller segments and adding other decorative elements. It is also

possible to completely create the décor in a computer equipped for graphic design. It is possible to create a simulated décor so realistic that even a professional will have great problems in visually separating it from genuine material. This makes it possible to make for example floor boards with an almost perfect illusion of a rare kind of wood, like ebony or rose wood and still preserving trees under threat of extermination.

The digital décor is used together with guiding programs to control a printer. The printer may be of an electrostatic type or an inc-jet type printer. The resolution needed is much depending on the décor that is to be simulated, but resolutions of 10 - 1500 dots per inch (dpi) is the practical range in which most décor will be printed. Under normal conditions a resolution of 300 - 800 dpi is sufficient when creating simulations of even very complex decorative patterns and still achieve a result that visually is very difficult to separate from the archetype without close and thorough inspection.

The digitally stored décor can also be used together with support programs when guiding other operations and procedures in the manufacturing process. Such steps in the operation may include procedures like identification marking, packaging, lacquering, surface embossing, storing and delivery logistics as well as assembly instructions.

It is advantageous to manufacture the supporting core in the desired end user format and to provide it with edges suited for joining before applying the décor and wear layer, since the amount of waste thereby is radically reduced. The décor matching tolerances will also be improved further by this procedure.

The main part of the supporting core is suitably constituted by a particle board or a fibre board. It is, however, possible to manufacture the core that at least partly consist of a polymer such as for example polyurethane or a polyolefin such as polyethylene, polypropylene or polybutene. A polymer based core can be achieved by being injection moulded or press moulded and can be given its shape by plastic moulding and does therefore not require any abrasive treatment. A polymer based core may except polymer also contain a filler in the form of a

particle or fibre of organic or inorganic material, which besides the use a cost reducing material also will be used to modify the mechanical characteristics of the core. As an example of such suitable fillers can be mentioned; cellulose or wood particles, straw, starch, glass, lime, talcum, stone powder and sand. The mechanical characteristics that may be changed is for example viscosity, thermal coefficient of expansion, elasticity, density, fire resistance, moisture absorption capacity, acoustic properties, thermal conductivity, flexural and shearing strength as well as softening temperature.

The upper surface, i.e. the surface that is to be provided with décor, is suitably surface treated before the printing. Such surface treatment will then incorporate at least one of the steps, ground coating and sanding. It is also possible to provide the surface with a structure that matches the décor that is to be applied.

The translucent wear layer is suitably constituted by a UV- or electron beam curing lacquer such as an acrylic, epoxy, or maleimide lacquer. The wear layer is suitably applied in several steps with intermediate curing where the last one is a complete curing while the earlier ones are only partial. It will hereby be possible to achieve thick and plane layers. The wear layer suitably includes hard particles with an average particle size in the range 50 nm - 150 µm. Larger particles, in the range 10 µm - 150 µm, preferably in the range 30 µm - 150 µm, is foremost used to achieve abrasion resistance while the smaller particles, in the range 50 nm - 30 µm, preferably 50 nm - 10 µm is used for achieving scratch resistance. The smaller particles is hereby used closest to the surface while the larger ones are distributed in the wear layer. The hard particles are suitably constituted of silicon carbide, silicon oxide, α-aluminium oxide and the like. The abrasion resistance is hereby increased substantially. Particles in the range 30 mm - 150 mm can for example be sprinkled on still wet lacquer so that they at, least partly, becomes embedded in finished wear layer. It is therefore suitable to apply the wear layer in several steps with intermediate sprinkling stations where particles are added to the surface. The wear layer can hereafter be cured. It is also possible to mix smaller particles, normally particle sizes under 30 µm with a standard lacquer. Larger particles may be added if a gelling agent or the like is present. A lacquer with smaller particles is suitably used as top layer coatings, closer to the upper surface.

The scratch resistance can be improved by sprinkling very small particles in the range 50 nm - 1000 nm on the uppermost layer of lacquer. Also these, so called nano-particles, can be mixed with lacquer, which with is applied in a thin layer with a high particle content. These nano-particles may besides silicon carbide, silicon oxide and α-aluminium oxide also be constituted of diamond.
The décor on the surface elements is suitably constituted by a number of decor segments with intermediate borders, which borders, on at least two opposite edges coincides with intended, adjacent surface elements.

Thus, the invention relates to a process for providing the decorative surface elements with a surface structure that in all essential aspects matches the décor. The decorative surface element also comprises a base layer and a decorative upper surface. The invention is characterised in that;

i) A wetting repellent lacquer is printed in a predetermined pattern on the decorative upper surface, the wetting repellent lacquer covering only parts of the decorative upper surface.

ii) A wear layer of a UV or electron beam curing lacquer is then applied on top of the decorative upper surface. The UV or electron beam curing lacquer is repelled from the parts of the surface being covered by the wetting repellent lacquer whereby a surface structure is achieved.

The UV or electron beam curing lacquer preferably consists of an acrylic, epoxy or a maleimide lacquer. The wear layer is preferably applied in several steps with intermediate partial curing. The wear layer preferably also includes hard particles with an average particle size in the range 50nm - 150µm in order to increase the wear resistance. These hard particles suitably consists of for example silicon oxide, α-aluminium oxide or silicon carbide. According to an alternative embodiment of the invention the main part of the hard particles may consists of the silicon oxide, α-aluminium oxide or silicon carbide while a smaller amount of the hard particles consist of diamond. The hard particles consisting of diamond is then in the average particle size range 50nm - 2µm and is placed close to the upper surface of the wear layer.

The wetting repellent lacquer is preferably also constituted of a UV or electron beam curing lacquer and with a content of silicone polymer. It is suitable to use a wetting repellent lacquer which also comprises UV or electron beam curing acrylic, epoxy or a maleimide lacquer and thereby is chemically compatible with the wear layer.. The wetting repellent lacquer is suitably translucent or semi-translucent.

It is possible to enhance the structuring by adding pigmentation in the wetting repellent lacquer which will create a shadow effect in the structure. According to an alternative the wetting repellent lacquer includes a matting agent which also creates a structure enhancing effect in the structure. It is of cause possible to combine the two methods. The wetting repellent lacquer is suitably cured before the step where the wear layer is applied.

As described earlier, the decorative upper surface comprises a decor layer, which decor layer originates from a digitally stored original. The digitally stored original is preferably processed in order to achieve a digital structure original whereby a surface structure that in every essential aspect matches the decor is achieved. The wetting repellent lacquer is then suitably applied by means of an ink-jet printer which may be controlled by a computer.

The base layer suitably consists of a particle board or a fibre board but may also mainly consist of a polymer such as polyurethane.

It is according to the present invention possible to achieve matching structure on even particularly characteristic décor segments such as borderlines between simulated slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor. The structure may be stored as digital data. Said data may be used for guiding automated printers when providing said characteristic décor segments with a suitable surface structure. Said printing process is synchronised via the predetermined fixing point on the surface element.

The process described in the present application, for manufacturing surface elements is very advantageous from a logistic point of view since the number of steps when achieving a new décor is radically reduced. It is, according to the present invention possible to use digitally created or stored data for directly printing the décor on a surface element by using a ink-jet printer or a photo-static printer. The so-called set up time will thereby be very short, whereby even very special customer requirements may be met at a reasonable cost. It is according to the present invention possible to manufacture, for example, a world map with matching surface structure in very large format, stretching over a great number of surface elements without any disrupting deviations in décor and structure matching, to mainly the same cost as bulk produced surface elements. Since the décor and surface structure may be handled digitally all the way to the point of being applied to the surface of the core, set up times will be practically non-existent while at the same time a high degree of automation will be practicable. It is also possible to automatically provide the surface elements with identification and orientation marking which would make the installation of complex décor, like world maps in the example above, much easier. This has so far been impossible.

Surface elements manufactured as described above is suitably used as a floor covering material where the demands on stability and scratch and abrasion resistance is great. It is, according to the present invention, also possible to use the surface elements as wall and ceiling decorative material. It will however not be necessary to apply thick wear layer coatings in the latter cases as direct abrasion seldom occurs on such surfaces.

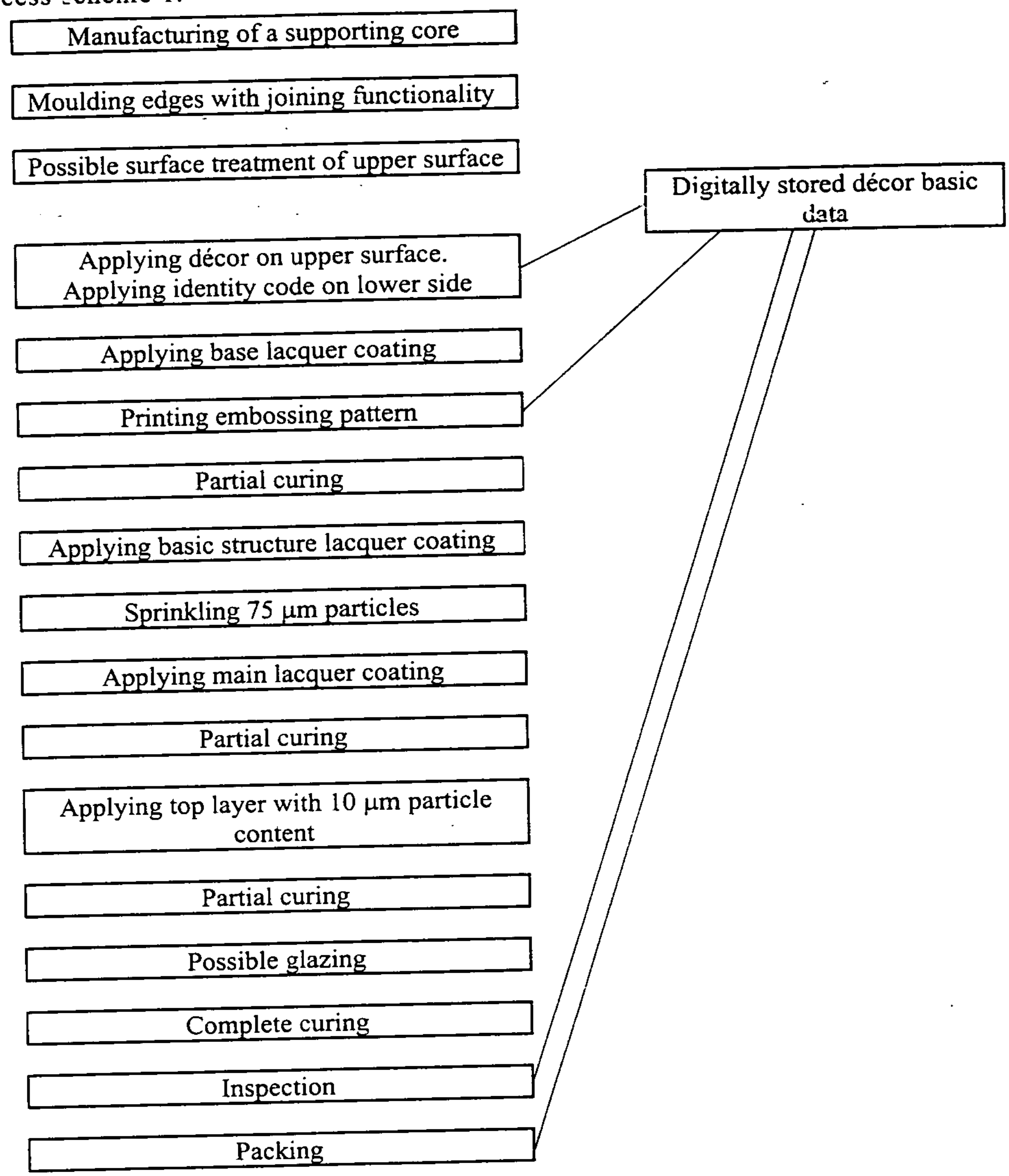
The invention is described further in connection to an enclosed figure, embodiment examples and schematic process descriptions showing different embodiments of the invention.

Accordingly, the figure shows parts of a surface element 1 which includes an upper decorative layer 2, edges 3 intended for joining, a lower side 4 and a supporting core 5. The process is initiated by manufacturing a supporting core 5

with a desired format and edges 3 intended for joining. The supporting core 5 is further provided with an upper side 1' suited for printing and a lower side 4. The upper side 1' of the supporting core 5 is then provided with a décor 2' by printing, utilising an inc-jet printer. The décor 2' is oriented after a predetermined fixing point on the supporting core 5. The upper side 1' of the supporting core 5 is provided with a protecting translucent wear layer 2" through curtain coating. The supporting core 5 is constituted by particle board or fibre board. The translucent wear layer 2" is constituted by a UV-curing acrylic lacquer which is applied in several steps with intermediate curing, of which the last one is a complete curing while the earlier ones are only partial curing. The wear layer 2" also includes hard particles of α-aluminium oxide with an average particle size in the range 0,5μm - 150μm.

The décor side of the surface element 1 is provided with a surface structure 2''' which enhances the realism of the décor 2'. It possible to simulate the surface structure of, for example, wood block chevron pattern décor.

Process scheme 1.



A supporting polymer and filler based core is manufactured in the desired format and is provided with an upper side, a lower side and edges provided with joining members, such as tongue and groove. The upper side of the supporting core is then sanded smooth after which a primer is applied. A décor is then applied on the

upper side by means of a digital photo-static five colour printer. The colours are magenta, yellow, cyan, white and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length is selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a supporting core. The digital image of the wood blocks are then classified after wood grain pattern and colour so that a number of groups is achieved. The groups are; fair wood with even grain, dark wood with even grain, fair wood with knots and flaws, dark wood with knots and flaws, fair cross-grained wood and finally dark cross-grained wood. Each group contains five different block simulations. An algorithm is feed into a computer which is used for the guiding of the printing operation so that the simulated wood blocks is digitally placed in three longitudinal rows and mixed so that two similar wood blocks never is placed next to each other. The algorithm will also guide the position of the latitudinal borderlines between the simulated wood blocks so that they are unaligned with more than one block width between adjacent rows. It will also guide the latitudinal position of the borderlines so that it either aligns with the shorter edges of the supporting core or is unaligned with more than one block width. Another printer, also guided by the computer, is utilised for printing a running matching number on the lower side short side edges. The décor will hereby continue longitudinally over the surface elements and a perfect matching is obtained when the surface elements are placed in numerical order.

A basic layer of UV-curing acrylic lacquer is then applied by means of a rollers. The basic layer is then cured to the desired viscosity. The surface structuring is then initiated by printing the part of the structure that is to form recesses in the finished surface. A UV-curing acrylic wetting repellent lacquer with a content of silicone polymer is printed by means of an ink-jet printer in the desired pattern. The pattern is made up by narrow lines of varying length and will cover less than

5% of the total surface of the surface element. The ink-jet printer is controlled by a computer where the digital décor used earlier is processed to receive a digital structure matching the décor in aspects like grain direction and density, flaws, knots and border lines between simulated wood blocks. This processing may be achieved by an automatic process where an algorithm is used as a digital filter or by manual operation during the scanning procedure. By this procedure a surface structure matching all essential aspects of the décor is achieved.

A second basic layer of UV-curing acrylic lacquer is then applied by means of a rollers. The lacquer will be repelled from the parts of the surface where the wetting repellent lacquer is present resulting in recesses in the surface. Particles with an average particle size in the range 75 µm is then sprinkled onto the still wet second basic layer, whereby the main layer of UV-curing acrylic lacquer is applied by roller coating. The lacquer is then cured using UV-light whereby the viscosity of the lacquer increases. A top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 10 µm, is then applied by means of a roller. The lacquer is then cured with UV-light so that the viscosity increases. It may, in some cases, be advantageous to perform a glazing operation on the top surface in order to make the edges between the main upper surface and the recesses more well defined. This is suitably achieved by pressing a heated roller towards the surface. The surface temperature of the roller is then suitably between 40 and 150°C.

The lacquer is then, if not already completely cured at a prior stage in the process, completely cured with UV-light to desired strength. The finished surface elements may then be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches which are provided with identification markings.

The process above will make it possible to have a completely customer driven manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear to anyone skilled in the art, that a décor is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and

identification marking may be controlled and supervised by central processing data. This will make it logistically possible to manufacture customer designed décor. Such a process is exemplified as follows;

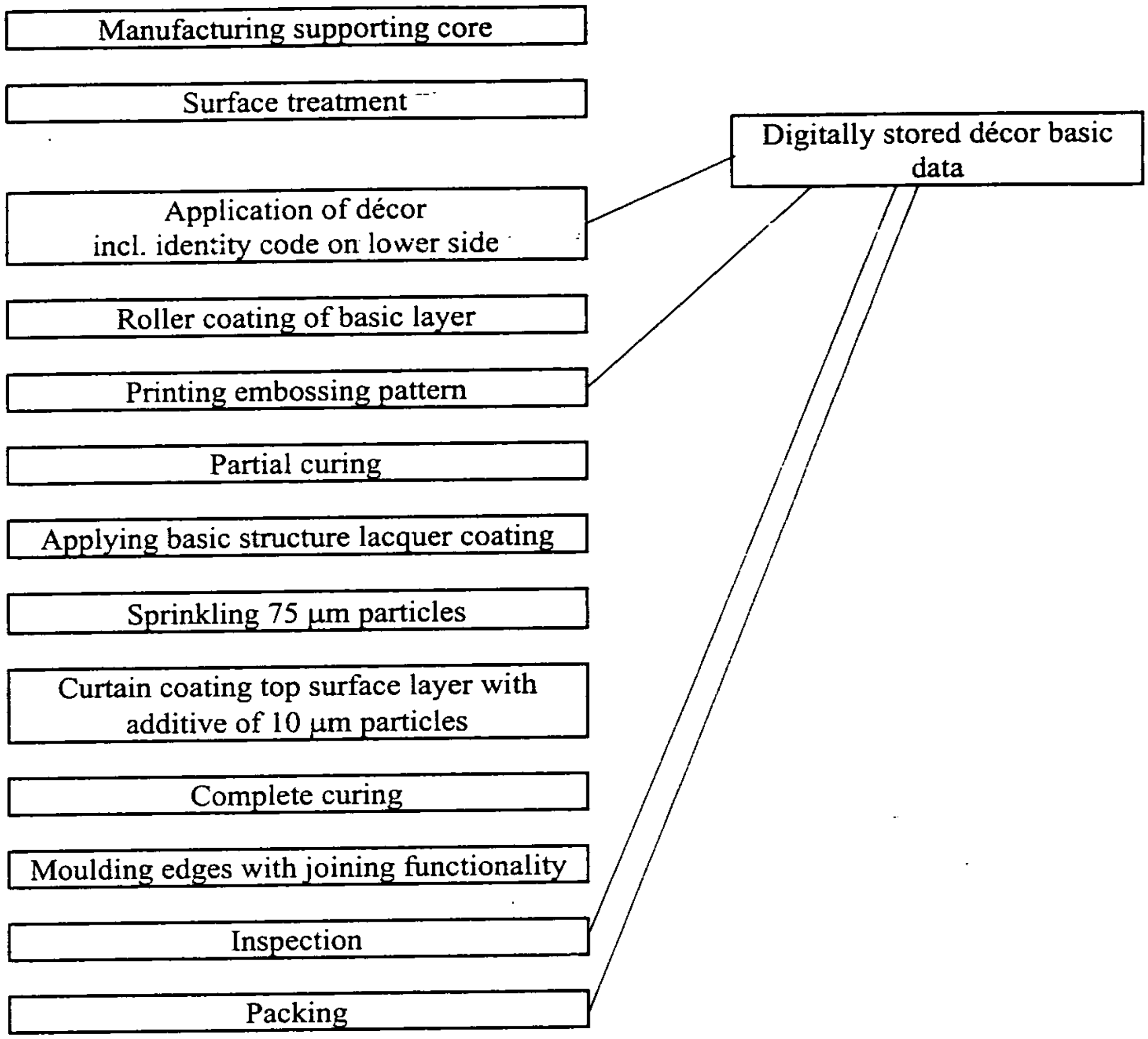
The customer utilises a database via Internet or at a local dealer. It is also possible for another operator utilise a database. The database contains samples and/or reduced resolution copies of a great variety of standard décor which can be combined after predetermined parameters.

The parameters may, for example, concern a single surface element where, for example, chevron pattern, diamond pattern and block pattern may be the choices of décor segmentation. It will here be possible to select a set of different simulations to randomly or by selected parameters fill the segments, for example, marble, birch and mahogany. The customer may also add an inlay from a design of his own which is digitised and processed, preferably automatically, to a desired format and resolution.

The parameters may alternatively include décor segments that requires the space of several surface elements, for example a map over the world. The parameters may here further include fading of the larger design to a surrounding décor, surrounding frame of other décor etc.

The customers enters the measurements of the surface that is to be covered by the surface elements. The customer then makes selections from the database and is able to see his selection as a completed surface, either on screen or by printing. The visualisation program used, is suitably also used for calculating installation pattern and presenting installation instructions with identification numbers on surface elements and where to cut the elements in order to make a perfect match. The surface elements may also be provided with removable matching lines on the decorative side making matching of décor between adjacent rows easier. The customer or dealer may then confirm his order via electronic mail where the pattern and décor is reduced to a code sequence and the order can be the direct input to the computer guiding the manufacturing process as described above. The customer and/or dealer data follows the manufacturing process all the way to packaging and a fully customer guided manufacturing process is achieved.

Process scheme 2



A supporting fibre board based core is manufactured in the desired format and is provided with an upper side, a lower side and edges. The upper side of the supporting core is then sanded smooth after which a white primer is applied. A décor is then applied on the upper side by means of a digital inc-jet four colour printer. The colours are magenta, yellow, cyan and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A

number of rectangular blocks with a fixed width, but of varying length are selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a finished surface element. The digital image of the wood blocks are then joined digitally to form a rectangular surface of a specified size, for example, 200 x 1200 mm. A selected amount of such combinations of different blocks are designed as described above so that a number of slightly different rectangular surfaces is achieved. The printer, or preferably a set of printers are positioned so that a desired number of rectangular décor surfaces with a specified intermediate distance is printed on the supporting core. The intermediate distance between the rectangular surfaces is the distance needed for parting and moulding of edges. The décor printer or printers are also used for printing fixing points at predetermined positions. Another printer, also guided by the computer, is utilised for printing an identity code on the lower side of each intended finished surface element.

A basic layer of UV-curing acrylic lacquer is then applied by means of rollers. The surface structuring is then initiated by printing the part of the structure that is to form recesses in the finished surface. A UV-curing acrylic wetting repellent lacquer with a content of silicone polymer is printed by means of an ink-jet printer in the desired pattern. The pattern is made up by narrow lines of varying length and will cover less than 5% of the total surface of the surface element. The ink-jet printer is controlled by a computer where the digital décor used earlier is processed to receive a digital structure matching the décor in aspects like grain direction and density, flaws, knots and border lines between simulated wood blocks. This processing may be achieved by an automatic process where an algorithm is used as a digital filter or by manual operation during the scanning procedure. By this procedure a surface structure matching all essential aspects of the décor is achieved.

A second basic layer of UV-curing acrylic lacquer is then applied by means of rollers. The lacquer will be repelled from the parts of the surface where the wetting repellent lacquer is present resulting in recesses in the surface. Particles with an average particle size in the range 75 μm is then sprinkled onto the still wet second basic layer, whereby the main layer of UV-curing acrylic lacquer with an

additive in the form of hard particles with an average size of 10 µm, is applied by means of a roller. The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface element is cut into the predetermined formats which are provided with edges with joining functionality are moulded by milling. The cutting and edge moulding process is positioned from fixing point printed close to the décor. The surface elements may then be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

It is, according to an alternative procedure in the process, possible to cut and mould the edges at an earlier stage in the process. It is suitable to apply and cure a protecting layer of lacquer and possibly the UV-curing acrylic wetting repellent lacquer on top of the printed décor followed by cutting and moulding of the edges. The remaining and main part of the wear layer is then applied as described in connection to process scheme 1 or 2 above.

The process above will make it possible to have a customer initiated manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear anyone skilled in the art, that décor is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data.

The invention is also described through embodiment examples.

EXAMPLE 1.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a structured wear layer was then initiated by applying 10g/m² of UV-curing acrylic lacquer by means of roller coating. The surface structuring was then initiated by printing the part of the structure that is to form recesses in the

finished surface. A UV-curing acrylic wetting repellent lacquer with a content of silicone polymer was printed by means of an ink-jet printer in the desired pattern. The pattern was made up by narrow lines of varying length and covered less than 2% of the total surface of the surface element. The wetting repellent lacquer was then exposed to a predetermined energy amount of UV-light so that it cured. 30g/m² of UV-curing acrylic lacquer by means of roller coating. The lacquer was repelled from the parts of the surface where the wetting repellent lacquer was present which resulted in recesses in the surface. 20g/m² of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Residual particles were then removed by blowing a high pressure air stream over the surface. Another 30g/m² of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20g/m² of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Again, residual particles were then removed by blowing a high pressure air stream over the surface. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate partial curing as a above. Each of the three layers had a surface weight of 20g/m². The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of 10g/m². The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second and a third layer of the topcoat lacquer was then applied and partly cured as described above. All layers were then

exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 7000 turns was obtained. An IP value of 7000 turns is fully sufficient for floor covering materials with medium to heavy traffic like hotel lobbies, hallways and the like.

EXAMPLE 2.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 30g/m² of UV-curing acrylic lacquer by means of roller coating. 20g/m² of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30g/m² of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20g/m² of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of 20g/m². The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved. Also the uppermost of the three layers of lacquer was cured to a desired viscosity.

A second décor layer was then printed on top of the wear layer. The second décor layer, which was identical to the first décor closest to the core, was oriented and positioned so that it completely matched the first décor. The build up of a structured upper wear layer was then initiated by applying 10g/m² of UV-curing acrylic lacquer by means of roller coating. The surface structuring was then

initiated by printing the part of the structure that is to form recesses in the finished surface. A UV-curing acrylic wetting repellent lacquer with a content of silicone polymer was printed by means of an ink-jet printer in the desired pattern. The pattern was made up by narrow lines of varying length and covered less than 2% of the total surface of the surface element. The wetting repellent lacquer was then exposed to a predetermined energy amount of UV-light so that it cured. 30g/m² of UV-curing acrylic lacquer by means of roller coating. The lacquer was repelled from the parts of the surface where the wetting repellent lacquer was present which resulted in recesses in the surface. 20g/m² of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Residual particles were then removed by blowing a high pressure air stream over the surface. Another 30g/m² of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20g/m² of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Again, residual particles were then removed by blowing a high pressure air stream over the surface. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of 20g/m². The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of 10g/m². The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second and a third layer of the topcoat lacquer

was then applied and partly cured as described above. The wear layer was exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 13200 turns was obtained. An IP value of 13200 turns is fully sufficient for floor covering materials with heavier traffic like airports, railway stations and the like. The second layer of décor and wear layer will add abrasion resistance without having obtained an unwanted hazy effect in the décor.

EXAMPLE 3.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a structured wear layer was then initiated by applying 10g/m² of UV-curing acrylic lacquer by means of roller coating. The surface structuring was then initiated by printing the part of the structure that is to form recesses in the finished surface. A UV-curing acrylic wetting repellent lacquer with a content of silicone polymer was printed by means of an ink-jet printer in the desired pattern. The pattern was made up by narrow lines of varying length and covered less than 2% of the total surface of the surface element. The wetting repellent lacquer was then exposed to a predetermined energy amount of UV-light so that it cured. 15g/m² of UV-curing acrylic lacquer by means of roller coating. The lacquer was repelled from the parts of the surface where the wetting repellent lacquer was present which resulted in recesses in the surface. 20g/m² of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Residual particles were then removed by blowing a high pressure air stream over the surface. One layer of UV-curing acrylic lacquer was then applied by roller coating and was partially cured as above. The layer had a surface weight of

$40 g/m^2$. The hard particles were embedded in the lacquer after the layer of lacquer was applied and a mainly plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of $10 g/m^2$. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second, final layer of the topcoat formulation was then applied on top of the previous layer. Also the second layer of top coat was applied to a surface weight of $10 g/m^2$. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 3000 turns was obtained. An IP value of 3000 turns is fully sufficient for floor covering materials with light traffic like bedrooms, living rooms and the like.

EXAMPLE 4.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The surface structuring was then initiated by printing the part of the structure that is to form recesses in the finished surface. A UV-curing acrylic wetting repellent lacquer with a content of silicone polymer was printed by means of an ink-jet printer in the desired pattern. The pattern was made up by narrow lines of varying length and covered less than 1% of the total surface of the surface element. The wetting repellent lacquer was then exposed to a predetermined energy amount of UV-light so that it cured. $50 g/m^2$ of UV-curing acrylic lacquer which contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm were applied by means of roller coating. The lacquer was repelled from the parts of the surface where the wetting repellent

lacquer was present which resulted in recesses in the surface. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layer. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of $10 g/m^2$. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 280 turns was obtained. An IP value of 280 turns could be sufficient for floor covering materials with light traffic like bedrooms, living rooms and the like.

The invention is not limited to the embodiments shown as these can be varied in different ways within the scope of the invention. It is for example possible to plane the surface by pressing one or more glazing rollers towards the surface structured wear layer before or after the complete curing stage. The glazing rollers are preferably also heated to a surface temperature above 30°C, preferably in the range 35°C - 100°C.

The hard particles added to the lacquer consists of for example silicon oxide, α-aluminium oxide or silicon carbide. According to one embodiment of the invention the main part of the hard particles consists of for example silicon oxide, α-aluminium oxide or silicon carbide while a smaller amount of the hard particles consist of diamond. The hard particles consisting of diamond is then in the average particle size range 50nm - 2μm and is placed close to the upper surface of the wear layer.

CLAIMS

1. A process for the manufacturing of a decorative surface element, which element comprises a base layer and a decorative upper surface, c h a r a c t e r i s e d in that,
   i) a wetting repellent lacquer is printed in a predetermined pattern on the decorative upper surface, the wetting repellent lacquer covering only parts of the decorative upper surface whereupon,
   ii) a wear layer of a UV or electron beam curing lacquer is applied on top of the decorative upper surface which UV or electron beam curing lacquer is repelled from the parts of the surface being covered by the wetting repellent lacquer whereby a surface structure is achieved.

2. A process according to claim 1, c h a r a c t e r i s e d in that the UV or electron beam curing lacquer consists of an acrylic, epoxy or a maleimide lacquer.

3. A process according to claim 1 or 2, c h a r a c t e r i s e d in that the wear layer is applied in several steps with intermediate partial curing.

4. A process according to any of the claims 1 - 3, c h a r a c t e r i s e d in that the wear layer includes hard particles with an average particle size in the range 50nm - 150μm.

5. A process according to claim 4, c h a r a c t e r i s e d in that the hard particles consists of for example silicon oxide, α-aluminium oxide or silicon carbide.

6. A process according to claim 4, c h a r a c t e r i s e d in that the main part of the hard particles consists of for example silicon oxide, α-aluminium oxide or silicon carbide while a smaller amount of the hard particles consist of diamond.

7. A process according to claim 6, c h a r a c t e r i s e d in that the hard particles consisting of diamond is in the average particle size range 50nm - 2μm and is placed close to the upper surface of the wear layer.

8. A process according to claim 1, c h a r a c t e r i s e d in that the wetting repellent lacquer is constituted of a UV or electron beam curing lacquer with a content of silicone polymer.

9. A process according to claim 8, c h a r a c t e r i s e d in that the wetting repellent lacquer comprises UV or electron beam curing acrylic, epoxy or a maleimide lacquer.

10. A process according to claim 8 or 9, c h a r a c t e r i s e d in that the wetting repellent lacquer is translucent.

11. A process according to claim 8 or 9, c h a r a c t e r i s e d in that the wetting repellent lacquer is semi-translucent.

12. A process according to claim 11, c h a r a c t e r i s e d in that the wetting repellent lacquer includes pigmentation which creates a structure enhancing shadow effect in the structure.

13. A process according to claim 11, c h a r a c t e r i s e d in that the wetting repellent lacquer includes a matting agent which creates a structure enhancing effect in the structure.

14. A process according to claim 8 or 9, c h a r a c t e r i s e d in that the wetting repellent lacquer is cured before the step where the wear layer is applied.

15. A process according to claim 1, c h a r a c t e r i s e d in that the decorative upper surface comprises a decor layer, which decor layer originates from a digitally stored original, that the digitally stored original is processed in order to achieve a digital structure original whereby a surface structure that in every essential aspect matches the decor is achieved.

16. A process according to claim 8 or 11, c h a r a c t e r i s e d in that the wetting repellent lacquer is applied by means of an ink-jet printer.

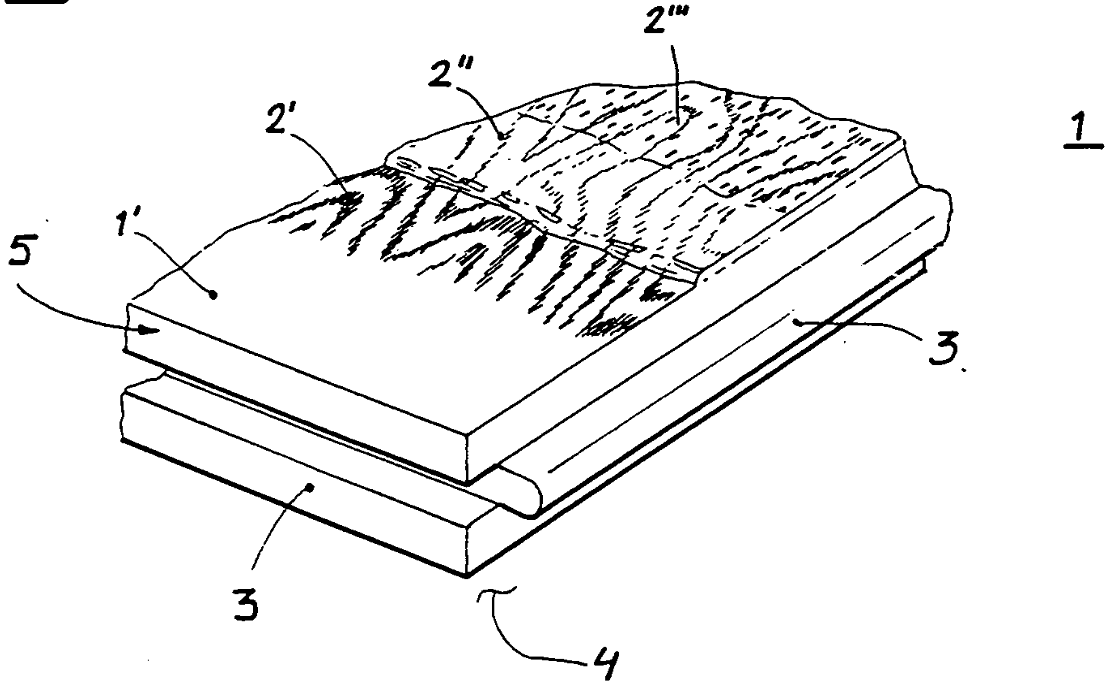
17. A process according to claim 1, c h a r a c t e r i s e d in that the base layer consists of a particle board or a fibre board.

18. A process according to claim 1, c h a r a c t e r i s e d in that the base layer consists mainly of a polymer such as polyurethane.

ABSTRACTS:

A process for the manufacturing of a decorative surface element, which element comprises a base layer and a decorative upper surface. A wetting repellent lacquer is printed in a predetermined pattern on the decorative upper surface. The wetting repellent lacquer covers only parts of the decorative upper surface. A wear layer of a UV or electron beam curing lacquer is then applied on top of the decorative upper surface which UV or electron beam curing lacquer is repelled from the parts of the surface being covered by the wetting repellent lacquer whereby a surface structure is achieved.

Fig.



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A process for achieving a wear resistant translucent surface on surface elements.

The present invention relates to a process for achieving a wear resistant translucent surface on surface elements with a decorative upper surface of which the decorative elements have an considerably improved matching of the décor between adjacent surface elements.

Products clad with thermosetting laminate is common in many areas nowadays. They are mostly used where the demands on abrasion resistance are high, and furthermore where resistance to different chemicals and moisture is desired. As examples of such products floors, floor skirtings, table tops, work tops and wall panels can be mentioned.

The thermosetting laminate most often consist of a number of base sheets with a decor sheet placed closest to the surface. The decor sheet can be provided with a pattern by desire. Common patterns usually visualise different kinds of wood or mineral such as marble and granite.

One common pattern on floor elements is the rod pattern where two or more rows of rods of, for example wood, is simulated in the décor.

The traditional thermosetting laminate manufacturing includes a number of steps which will result in a random matching tolerance of up to ±5mm, which is considered to great. The steps included in the manufacturing of a laminate floor is; printing decor on a paper of α-cellulose, impregnating the decorative paper with melamine-formaldehyde resin, drying the decorative paper, laminating the decorative paper under heat and pressure together with similarly treated supporting papers, applying the decorative laminate on a carrier and finally sawing and milling the carrier to the desired format. All these steps in the manufacturing will cause a change in format on the decor paper. It will therefore be practically impossible to achieve a desired match of patterns between the elements of a without causing great amounts of wasted laminate. The thermosetting laminate is a rather costly part of a laminate floor.

It has, through the present invention, been made possible to overcome the above mentioned problems and a surface element with a decorative surface where the decorative pattern between different surface elements is matching has been obtained. The invention relates to a process for achieving décor on surface elements which comprises a decorative upper layer and a supporting core.

The surface elements may be used as floor, wall or ceiling boards. The surface elements are suitably manufactured through the following process;

i) A supporting core with a desired format is manufactured and provided with an upper side and a lower side.

ii) The upper side of the supporting core is then provided with a décor, by for example printing. The décor is positioned after a predetermined fixing point on the supporting core.

iii) The upper side of the supporting core is then provided with a protecting, at least partly translucent, wear layer by for example spray coating, roller coating, curtain coating and immersion coating or by being provided with one or more sheets of α-cellulose impregnated with thermosetting resin or lacquer.

The décor is preferably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is preferably stored digitally in order to be used as a control function and original, together with control programs and selection parameters, when printing the décor.

The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and support programs calculates an installation pattern. The installation pattern calculation is suitably also used for printing an assembly instruction. In order to visualise the selection the installation pattern calculation is possibly used for printing a miniaturised copy of the calculated installation with the selected pattern and décor. The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and that that support programs further calculates décor and segmentation pattern matching between the surface elements.

The selections is preferably also used, together with support programs for controlling further steps in the manufacturing procedure selected from the group; identification marking, positioning marking, packaging, lacquering, surface embossing, storing and delivery logistics.

An algorithm is suitably used for guiding the positioning of the décor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element. The control program is suitably used, together with décor data and selection parameters, for applying matching identification on the surface elements.

Thus, the invention relates to a process for achieving a wear resistant translucent surface on surface elements which comprises a decorative upper layer and a supporting core. The invention is characterised in that a number of layers of UV- or electron-beam curing lacquer are applied on a decorative surface, through a process comprising the steps;

i) A base layer of lacquer is applied to a surface weight of 5 - 50 g/m².
ii) Hard particles with an average particle size in the range 10 - 150 μm are then sprinkled to an amount of 1 - 40 g/m² on the still wet lacquer.
iii) The applied layer of lacquer is then cured to a desired viscosity.
iv) A covering layer of lacquer is then applied to a surface weight of 5 - 150 g/m².
v) The applied layer of lacquer is then cured to a desired viscosity whereupon,
vi) a topcoat layer of lacquer with an additive of 5 - 35% of hard particles with an average size in the range 50nm - 30μm is applied to a surface weight of 2 - 20g/m².
vii) The applied layers of lacquer are cured to a desired final viscosity.

The lacquer is suitably a UV or electron beam curing acrylic, epoxy or maleimide lacquer. The lacquer does suitably comprise a reaction mechanism selected from the group; cationic, free-radical, and thiol/ene, and is preferably photo initiator free.

According to an embodiment of the invention second base layer of lacquer is applied to a surface weight of 5 - 50 g/m² on top of the sprinkled hard particles after the curing process. A second layer of hard particles with an average particle size in the range 10 - 150 μm is then sprinkled to an amount of 1 - 40 g/m² on the still wet lacquer of the second base layer whereupon the applied layer of lacquer is cured to a desired viscosity before applying the covering layer.

The base layer is suitably applied in several steps with intermediate curing to a

desired viscosity, each step comprising application of lacquer to a surface weight of 5 - 40 g/m². The covering layer is suitably applied in several steps with intermediate curing to a desired viscosity, each step comprising application of lacquer to a surface weight of 5 - 40 g/m². The topcoat layer is also suitably applied in several steps with intermediate curing to a desired viscosity, each step comprising application of lacquer to a surface weight of 5 - 40 g/m².

The décor is suitably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is stored digitally in order to be used as a control function and original, together with possible control programs, when printing the décor.

The décor may accordingly be obtained by making a high resolution or selected resolution digital picture of the desired décor. This is suitably made by means of a digital camera or scanner. The most common décor will of course be different kinds of wood and minerals like marble, as these probably will continue to be preferred surface decoration in home and public environments. It is, however, possible to depict anything that is visible. The digitised version of the décor is then edited to fit the size of the supporting core. It is also possible to rearrange the décor in many different ways, like changing colour tones, contrast, dividing the décor into smaller segments and adding other decorative elements. It is also possible to completely create the décor in a computer equipped for graphic design. It is possible to create a simulated décor so realistic that even a professional will have great problems in visually separating it from genuine material. This makes it possible to make for example floor boards with an almost perfect illusion of a rare kind of wood, like ebony or rose wood and still preserving trees under threat of extermination.

The digital décor is used together with guiding programs to control a printer. The printer may be of an electrostatic type or an ink-jet type printer. The resolution needed is much depending on the décor that is to be simulated, but resolutions of 10 - 1500 dots per inch (dpi) is the practical range in which most décors will be printed. Under normal conditions a resolution of 300 - 800 dpi is sufficient when creating simulations of even very complex decorative patterns and still achieve a result that visually is very difficult to separate form the archetype without close and thorough inspection.

The digitally stored décor can also bc used together with support programs when guiding other operations and procedures in the manufacturing process. Such steps in the operation may include procedures like identification marking, packaging, lacquering, surface embossing, storing and delivery logistics as well as assembly instructions.

It is advantageous to manufacture the supporting core in the desired end user format and to provide it with edges suited for joining before applying the décor and wear layer, since the amount of waste thereby is radically reduced. The décor matching tolerances will also be improved further by this procedure.

The main part of the supporting core is suitably constituted by a particle board or a fibre board. It is, however, possible to manufacture the core that at least partly consist of a polymer such as for example polyurethane or a polyolefin such as polyethylene, polypropylene or polybutene. A polymer based core can be achieved by being injection moulded or press moulded and can be given its shape by plastic moulding and does therefore not require any abrasive treatment. A polymer based core may except polymer also contain a filler in the form of a particle or fibre of organic or inorganic material, which besides the use a cost reducing material also will be used to modify the mechanical characteristics of the core. As an example of such suitable fillers can be mentioned; cellulose or wood particles, straw, starch, glass, lime, talcum, stone powder and sand. The mechanical characteristics that may be changed is for example viscosity, thermal coefficient of expansion, elasticity, density, fire resistance, moisture absorption capacity, acoustic properties, thermal conductivity, flexural and shearing strength as well as softening temperature.

The upper surface, i.e. the surface that is to be provided with décor, is suitably surface treated before the printing. Such surface treatment will then incorporate at least one of the steps, ground coating and sanding. It is also possible to provide the surface with a structure that matches the décor that is to be applied.

The translucent wear layer is suitably constituted by a UV- or electron beam curing lacquer such as an acrylic, epoxy, or maleimide lacquer. The wear layer is suitably applied in several steps with intermediate curing where the last one is a complete curing while the earlier ones are only partial. It will hereby be possible to achieve

thick and plane layers. The wear layer suitably includes hard particles with an average particle size in the range 50 nm - 150 μm. Larger particles, in the range 10 μm - 150 μm, preferably in the range 30 μm - 150 μm, is foremost used to achieve abrasion resistance while the smaller particles, in the range 50 nm - 30 μm, preferably 50 nm - 10 μm is used for achieving scratch resistance. The smaller particles is hereby used closest to the surface while the larger ones are distributed in the wear layer. The hard particles are suitably constituted of silicon carbide, silicon oxide, α-aluminium oxide and the like. The abrasion resistance is hereby increased substantially. Particles in the range 30 mm - 150 mm can for example be sprinkled on still wet lacquer so that they at, least partly, becomes embedded in finished wear layer. It is therefore suitable to apply the wear layer in several steps with intermediate sprinkling stations where particles are added to the surface. The wear layer can hereafter be cured. It is also possible to mix smaller particles, normally particle sizes under 30 μm with a standard lacquer. Larger particles may be added if a gelling agent or the like is present. A lacquer with smaller particles is suitably used as top layer coatings, closer to the upper surface. The scratch resistance can be improved by sprinkling very small particles in the range 50 nm - 1000 nm on the uppermost layer of lacquer. Also these, so called nano-particles, can be mixed with lacquer, which with is applied in a thin layer with a high particle content. These nano-particles may besides silicon carbide, silicon oxide and α-aluminium oxide also be constituted of diamond.

The décor on the surface elements is suitably constituted by a number of décor segments with intermediate borders, which borders, on at least two opposite edges coincides with intended, adjacent surface elements.

It is also desirable to provide the surface elements with a surface structure intended to increase the realism of the décor of the surface elements. This is suitably achieved by positioning at least one surface structured matrix, forming at least one surface structure segment on a corresponding décor segment or number of décor segments on the decorated surface of the surface element in connection to the application of wear

layer. This matrix is pressed towards the wear layer whereby this will receive a surface with structure that enhances the realism of the décor.

When simulating more complex patterns, like wood block chevron pattern or other décors with two or more divergent and oriented décors, it is suitable to use at least two structured matrixes which forms one structure segment each. The structure segment are here independent from each other in a structure point of view. The surface structure segments are intended to at least partly but preferably completely match the corresponding décor segments of the décor. The surface structure segments are accurately positioned on the décor side of the surface element in connection to the application of the wear layer, and is pressed onto this whereby the wear layer is provided with a surface structure where the orientation of the structure corresponds to the different directions in the décor.

One or more matrixes preferably forms the surface of one or more rollers. The surface element is then passed between the roller or rollers and counter stay rollers, with the décor side facing the structured rollers. The structured rollers are continuously or discontinuously pressed towards the décor surface of the surface element.

Rollers containing two or more matrixes, is suitably provided with a circumference adapted to the repetition frequency of change of direction in the décor.

It is also possible to apply the structure matrixes on the surface of a press belt. The surface element is then passed between the press belt and a press belt counter stay under continuous or discontinuous pressure between the structured press belt and the press belt counter stay.

It is, according to one alternative procedure, possible to have one or more matrixes form the structure surface of one or more static moulds which momentary is pressed towards the decorative side of the surface element.

According to one embodiment of the invention, particularly characteristic décor segments such as borderlines between simulated slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor, is stored as digital data. Said data is used for guiding automated engraving or pressing tools when providing said characteristic décor segments with a suitable surface structure,

and that said engraving tool or pressing tool is synchronised via the predetermined fixing point on the surface element.

According to an alternative embodiment of the invention a random structure is achieved by utilising at least one roller provided with an elastic and structured surface. A wear layer is achieved as described above after which the surface structure is applied. A roller covered with a structured elastic layer is pressed towards the upper surface of the surface element while it passes. A doctor roller transfers a selected amount of UV-curing lacquer to the structured roller which then transfers lacquer to the upper surface of the surface element. The depth and appearance of the structure achieved can be guided through the following parameters;

-The depth, selected structure and elasticity of the structured roller.

-The force used for pressing the doctor roller towards the structured roller.

-The amount of lacquer transferred by the doctor roller.

-The force used for pressing the structured roller towards the surface element.

If a thin layer of lacquer is applied on the doctor roller, the pressure between doctor roller and structured roller is low to moderate only the raised and protruding parts of the surface of the structured roller will be covered with lacquer. If also the pressure between the structured roller and the surface element is low to moderate, lacquer will be transferred to the surface element in a pattern corresponding to the protruding pattern of the structured roller. If the pressure between the structured roller and the surface element is high parts of the lacquer will be urged from the surfaces in contact resulting in ridges on both sides of the same contacting surfaces. If the amount of lacquer on the doctor roller is increased, these ridges will be thicker and wider to a point where a negative impression of the structure is achieved. It is also possible to achieve a similar effect by increasing the force between the doctor roller and the structured roller.

Since a roller is used for achieving the structure a certain repetition of the structure can be noted when distinct pattern occurs even though some variation can be achieved by varying the parameters above. The repetition frequency can be altered by changing the diameter of the roller. It is also possible to utilise a belt with structure. Such a belt can be made very long whereby the structure will repeat itself very seldom.

It is also possible to utilise two or more structured rollers with different diameter, otherwise utilising the process as described above. This will make it possible to achieve an endless variation in structure pattern, especially since all rollers used can be set individually at different pressure and layer thickness. A surface structure with a clearly notable pattern and without any notable repetition in the structure will create a more living surface and will give the impression of being hand-crafted.

The lacquer used for the structuring of the surface preferably contains 5 - 20 % by weight of hard particles of for example α-aluminium oxide, silicon oxide or silicon carbide with an average particle size in the range 2 - 15 μm. This will, above adding to the wear resistance of the wear layer as a whole, also prolong the time before the structure part of the surface is worn down. The lacquer is cured with a predetermined amount of UV-light after the application stage whereby it cures to the desired strength. It is also possible to utilise a heated glazing roller after the curing stage. This will make it possible to make the edges between the structure layer and the adjacent surface sharper and more well defined. This will make the structure more distinct. It is also possible to simulate very small, micro structure features as, for example, pores that normally occur in wood by pressing hard structured rollers on the cured structured surface achieved above.

The process described in the present application, for manufacturing surface elements is very advantageous from a logistic point of view since the number of steps when achieving a new décor is radically reduced. It is, according to the present invention possible to use digitally created or stored data for directly printing the décor on a surface element by using a ink-jet printer or a photo-static printer. The so-called set up time will thereby be very short, whereby even very special customer requirements may be met at a reasonable cost. It is according to the present invention possible to manufacture, for example, a world map in very large format, stretching over a great number of surface elements without any disrupting deviations in décor matching, to mainly the same cost as bulk produced surface elements. Since the décor may be handled digitally all the way to the point of being applied to the surface of the core, set up times will be practically non-existent while at the same time a high degree of automation will be practicable. It is also possible to automatically provide the surface elements with identification and orientation marking which would make the

installation of complex décors, like world maps in the example above, much easier. This has so far been impossible.

Surface elements manufactured as described above is suitably used as a floor covering material where the demands on stability and scratch and abrasion resistance is great. It is, according to the present invention, also possible to use the surface elements as wall and ceiling decorative material. It will however not be necessary to apply thick wear layer coatings in the latter cases as direct abrasion seldom occurs on such surfaces.

The invention is described further in connection to an enclosed figure, embodiment examples and schematic process descriptions showing different embodiments of the invention.

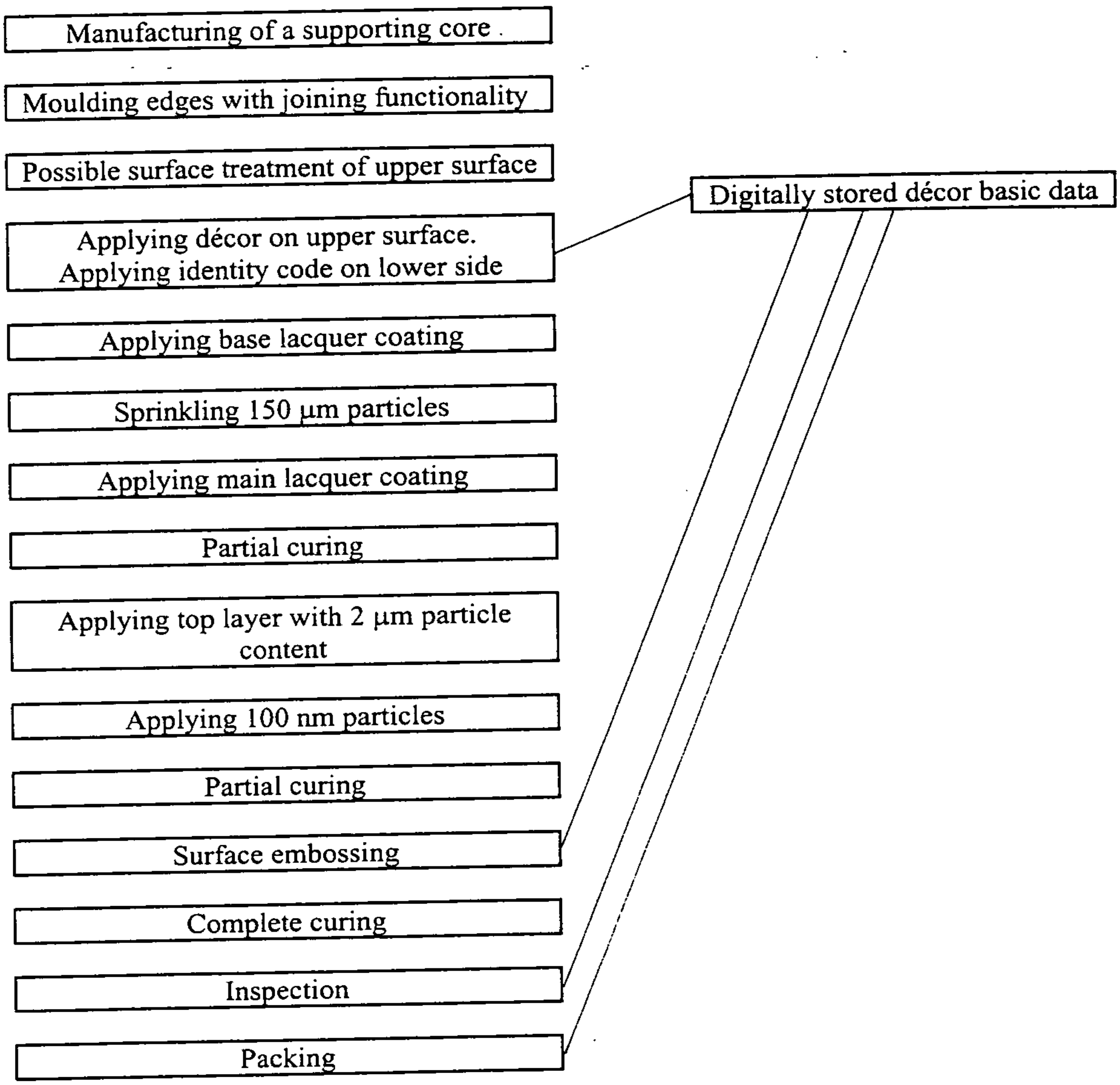
Accordingly, the figure shows parts of a surface element 1 which includes an upper decorative layer 2, edges 3 intended for joining, a lower side 4 and a supporting core 5. The process is initiated by manufacturing a supporting core 5 with a desired format and edges 3 intended for joining. The supporting core 5 is further provided with an upper side 1' suited for printing and a lower side 4. The upper side 1' of the supporting core 5 is then provided with a décor 2' by printing, utilising an ink-jet printer. The décor 2' is oriented after a predetermined fixing point on the supporting core 5. The upper side 1' of the supporting core 5 is then provided with a protecting translucent wear layer 2" through curtain coating. The supporting core 5 is constituted by particle board or fibre board. The translucent wear layer 2" is constituted by a UV-curing acrylic lacquer which is applied in several steps with intermediate curing, of which the last one is a complete curing while the earlier ones are only partial curing. The wear layer 2" also includes hard particles of α-aluminium oxide with an average particle size in the range 0,5µm - 150µm.

A surface structured matrix is positioned and pressed towards the décor side of the surface element 1 before the final curing of the acrylic lacquer whereby the surface of the wear layer 2" receives a surface structure 2'" which enhances the realism of the décor 2'.

It is also possible to utilise two or more surface structured matrixes, each forming a structure segment, between which the structure is independent, which will make it

possible to simulate the surface structure of, for example, wood block chevron pattern décor.

Process scheme 1.



A supporting polymer and filler based core is manufactured in the desired format and is provided with an upper side, a lower side and edges provided with joining members, such as tongue and groove. The upper side of the supporting core is then sanded smooth after which a primer is applied. A décor is then applied on the upper side by means of a digital photo-static five colour printer. The colours are magenta,

yellow, cyan, white and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length is selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a supporting core. The digital image of the wood blocks are then classified after wood grain pattern and colour so that a number of groups is achieved. The groups are; fair wood with even grain, dark wood with even grain, fair wood with knots and flaws, dark wood with knots and flaws, fair cross-grained wood and finally dark cross-grained wood. Each group contains five different block simulations. An algorithm is feed into a computer which is used for the guiding of the printing operation so that the simulated wood blocks is digitally placed in three longitudinal rows and mixed so that two similar wood blocks never is placed next to each other. The algorithm will also guide the position of the latitudinal borderlines between the simulated wood blocks so that they are unaligned with more than one block width between adjacent rows. It will also guide the latitudinal position of the borderlines so that it either aligns with the shorter edges of the supporting core or is unaligned with more than one block width. Another printer, also guided by the computer, is utilised for printing a running matching number on the lower side short side edges. The décor will hereby continue longitudinally over the surface elements and a perfect matching is obtained when the surface elements are placed in numerical order.

A basic layer of UV-curing acrylic lacquer is then applied by means of a rollers. Particles with an average particle size in the range 150 µm is then sprinkled onto the still wet basic layer, whereby the main layer of UV-curing acrylic lacquer is applied by spray coating. The two layers of lacquer are then partly cured using UV-light whereby the viscosity of the lacquer increases. A top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 2 µm, is then applied by means of a roller. Hard particles with an average size of 100 nm is then sprinkled on top of the wet top layer, whereby the lacquer is partly cured with UV-light so that the viscosity increases. The still soft lacquer is then provided with a

structure in the form of narrow, small, elongated recesses, simulating the pores of the wood. This will increase the realism of the décor. This is achieved by alternating between two different structured roller per row of simulated wood blocks. The structure of the rollers simulates even wood grain and cross-grained wood respectively. The rollers are alternately pressed towards the lacquered surface while it passes. The positioning of the rollers are guided via the digitally stored data used for printing the décor as well as the fixing point used there.

It is according to one alternative embodiment possible to utilise one or more static moulds with surface structure which momentary is pressed towards the décor side.

Especially characteristic décor segments such as borderlines between slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor, is suitably stored as digital data. This data is achieved by processing selected parts of the simulated wood blocks so that guiding data is achieved. Said data is then used for guiding an automated robot provided with an engraving tool or a press mould which provides the surface of the lacquer with a structure that matches said characteristic décor segments. The operation is also here synchronised via the predetermined fixing point on the supporting core.

The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface elements may be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

The process above will make it possible to have a completely customer driven manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear to anyone skilled in the art, that a décor is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data. This will make it logistically possible to manufacture customer designed décors. Such a process is exemplified as follows;

The customer utilises a database via Internet or at a local dealer. It is also possible for another operator utilise the database. The database contains samples and/or

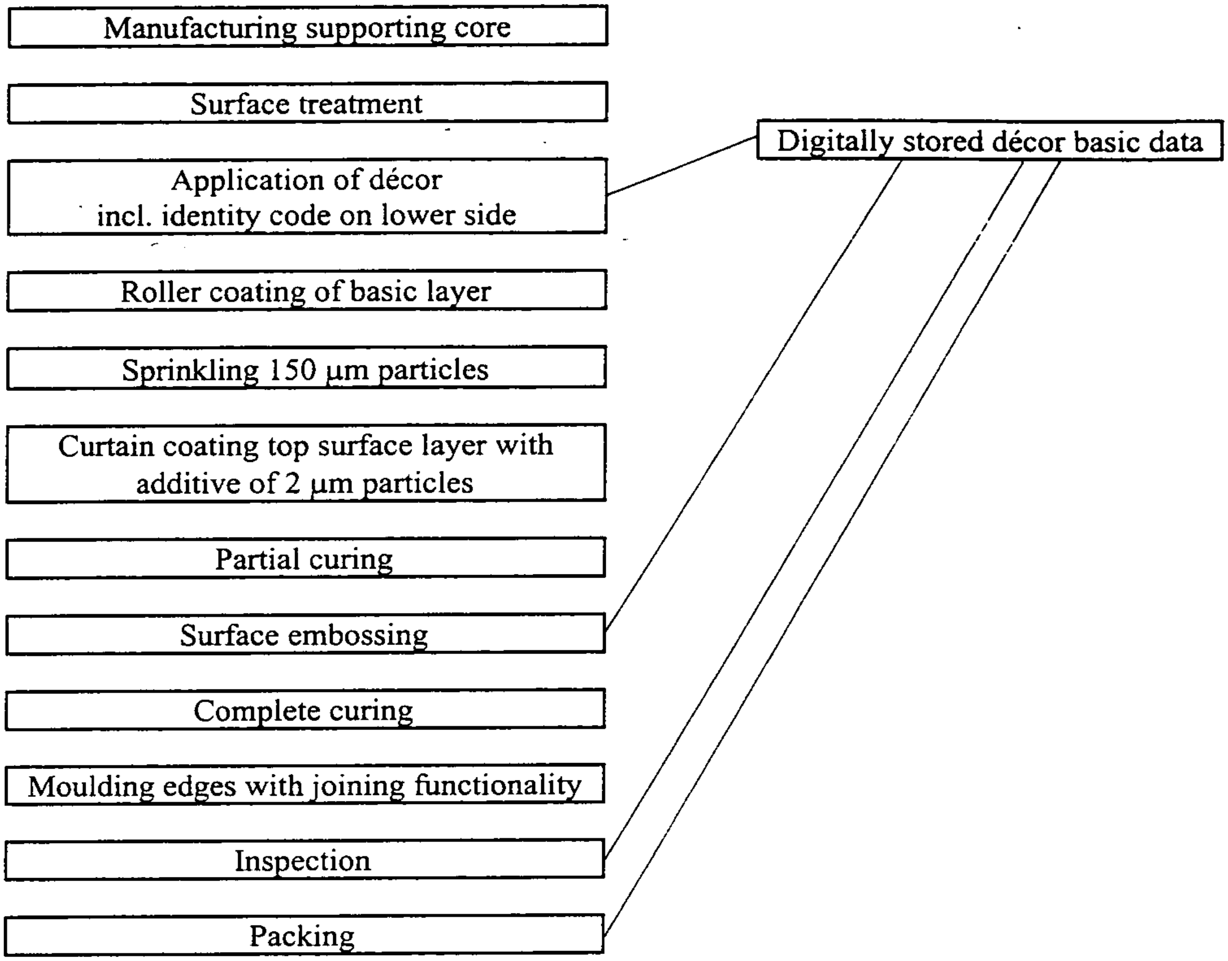
reduced resolution copies of a great variety of standard décors which can be combined after predetermined parameters.

The parameters may, for example, concern a single surface element where, for example, chevron pattern, diamond pattern and block pattern may be the choices of décor segmentation. It will here be possible to select a set of different simulations to randomly or by selected parameters fill the segments, for example, marble, birch and mahogany. The customer may also add an inlay from a design of his own which is digitised and processed, preferably automatically, to a desired format and resolution.

The parameters may alternatively include décor segments that requires the space of several surface elements, for example a map over the world. The parameters may here further include fading of the larger design to a surrounding décor, surrounding frame of other décor etc.

The customers enters the measurements of the surface that is to be covered by the surface elements. The customer then makes selections from the database and is able to see his selection as a completed surface, either on screen or by printing. The visualisation program used, is suitably also used for calculating installation pattern and presenting installation instructions with identification numbers on surface elements and where to cut the elements in order to make a perfect match. The surface elements may also be provided with removable matching lines on the decorative side making matching of décor between adjacent rows easier. The customer or dealer may then confirm his order via electronic mail where the pattern and décor is reduced to a code sequence and the order can be the direct input to the computer guiding the manufacturing process as described above. The customer and/or dealer data follows the manufacturing process all the way to packaging and a fully customer guided manufacturing process is achieved.

Process scheme 2



A supporting fibre board based core is manufactured in the desired format and is provided with an upper side, a lower side and edges. The upper side of the supporting core is then sanded smooth after which a white primer is applied. A décor is then applied on the upper side by means of a digital ink-jet four colour printer. The colours are magenta, yellow, cyan and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length are selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a finished surface element. The digital

image of the wood blocks are then joined digitally to form a rectangular surface of a specified size, for example, 200 x 1200 mm. A selected amount of such combinations of different blocks are designed as described above so that a number of slightly different rectangular surfaces is achieved. The printer, or preferably a set of printers are positioned so that a desired number of rectangular décor surfaces with a specified intermediate distance is printed on the supporting core. The intermediate distance between the rectangular surfaces is the distance needed for parting and moulding of edges. The décor printer or printers are also used for printing fixing points at predetermined positions. Another printer, also guided by the computer, is utilised for printing an identity code on the lower side of each intended finished surface element.

A basic layer of UV-curing acrylic lacquer is then applied by means of rollers. Particles with an average particle size in the range 150 μm is then sprinkled onto the still wet basic layer, whereby a top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 2 μm, is applied by means of a roller. Hard particles with an average size of 100 nm is then sprinkled on top of the wet top layer, whereby the lacquer is partly cured with UV-light so that the viscosity increases. The still soft lacquer is then provided with a structure in the form of narrow, small, elongated recesses, simulating the pores of the wood. This will increase the realism of the décor. This is achieved by pressing rollers towards the lacquered surface while it passes. The positioning of the rollers are guided via the digitally stored data used for printing the décor, as well as the fixing point used there when more complex and completely matching surface structures as described together with process scheme 1 is desired.

The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface element is cut into the predetermined formats which are provided with edges with joining functionality are moulded by milling. The cutting and edge moulding process is positioned from fixing point printed close to the décor. The surface elements may then be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

It is, according to an alternative procedure in the process, possible to cut and mould the edges at an earlier stage in the process. It is suitable to apply and cure a protecting layer of lacquer on top of the printed décor followed by cutting and

moulding of the edges. The remaining and main part of the wear layer is then applied as described in connection to process scheme 1 or 2 above.

The process above will make it possible to have a customer initiated manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear anyone skilled in the art, that décors is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data.

The invention is also described through embodiment examples.

EXAMPLE 1.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 30g/m² of UV-curing acrylic lacquer by means of roller coating. 20g/m² of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30g/m² of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20g/m² of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate partial curing as a above. Each of the three layers had a surface weight of 20g/m². The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly

cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of $10g/m^2$. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second layer of the topcoat lacquer was then applied and partly cured as described above. The wear layer was then provided with a surface structure by means of a surface structured roller. A third layer of the topcoat formulation was then applied on top of the structured wear layer. Also the third layer of top coat was applied to a surface weight of $10g/m^2$. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 7100 turns was obtained. An IP value of 7100 turns is fully sufficient for floor covering materials with medium to heavy traffic like hotel lobbies, hallways and the like.

EXAMPLE 2.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer. The build up of a wear layer was then initiated by applying $30g/m^2$ of UV-curing acrylic lacquer by means of roller coating. $20g/m^2$ of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another $30g/m^2$ of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another $20g/m^2$ of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of $20g/m^2$. The hard particles were completely embedded in the lacquer after

the three layers were applied and a plane upper wear layer surface was achieved. Also the uppermost of the three layers of lacquer was cured to a desired viscosity.

A second décor layer was then printed on top of the wear layer. The second décor layer, which was identical to the first décor closest to the core, was oriented and positioned so that it completely matched the first décor.

The build up of an upper wear layer was then initiated by applying 30g/m^2 of UV-curing acrylic lacquer by means of roller coating. 20g/m^2 of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30g/m^2 of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20g/m^2 of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of 20g/m^2. The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of 10g/m^2. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second layer of the topcoat lacquer was then applied and partly cured as described above. The wear layer was then provided with a surface structure by means of a surface structured roller. A third layer of the topcoat formulation was then applied on top of the structured wear layer. Also the third layer of top coat was applied to a surface weight of 10g/m^2. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 13500 turns was obtained. An IP value of 13500 turns is fully sufficient for floor covering materials with heavier traffic like airports, railway stations and the like. The second layer of décor and wear layer will add abrasion resistance without having obtained an unwanted hazy effect in the décor.

EXAMPLE 3.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 15g/m² of UV-curing acrylic lacquer by means of roller coating. 20g/m² of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. One layer of UV-curing acrylic lacquer was then applied by roller coating and was partially cured as above. The layer had a surface weight of 40g/m². The hard particles were embedded in the lacquer after the layer of lacquer was applied and a mainly plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of 10g/m². The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. The wear layer was then provided with a surface structure by means of a surface structured roller. A second, final layer of the topcoat formulation was then applied on top of the structured wear layer. Also the second layer of top coat was applied to a surface weight of 10g/m². The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 3100 turns was obtained. An IP value of 3100 turns is fully

sufficient for floor covering materials with light traffic like bedrooms, living rooms and the like.

EXAMPLE 4.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying $50 g/m^2$ of UV-curing acrylic lacquer which contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10µm by means of roller coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layer. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10µm. The first layer was applied to a surface weight of $10 g/m^2$. The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. The wear layer was then provided with a surface structure by means of a surface structured roller. A second, final layer of the topcoat formulation was then applied on top of the structured wear layer. Also the second layer of top coat was applied to a surface weight of $10 g/m^2$. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 300 turns was obtained. An IP value of 300 turns could be sufficient for floor covering materials with light traffic like bedrooms, living rooms and the like.

The invention is not limited to the embodiments shown as these can be varied in different ways within the scope of the invention. It is for example possible to achieve a random structure is by utilising at least one roller provided with an elastic and

structured surface which is pressed towards the upper surface of the surface element while it passes. A doctor roller transfers a selected amount of UV-curing lacquer to the structured roller which then transfers lacquer to the upper surface of the surface element. The lacquer is then cured with a predetermined amount of UV-light after the application stage whereby it cures to the desired strength.

CLAIMS

1. A process for achieving a wear resistant translucent surface on surface elements (1) which comprises a decorative upper layer (2) and a supporting core (5), c h a r a c t e r i s e d in that a number of layers of UV- or electron-beam curing lacquer are applied on a decorative surface, through a process comprising the steps;
   i) applying a base layer of lacquer to a surface weight of 5 - 50g/m² whereupon,
   ii) hard particles with an average particle size in the range 10 - 150 μm are sprinkled to an amount of 1 - 40 g/m² on the still wet lacquer whereupon,
   iii) the applied layer of lacquer is cured to a desired viscosity whereupon,
   iv) a covering layer of lacquer is applied to a surface weight of 5 - 150 g/m² whereupon,
   v) the applied layer of lacquer is cured to a desired viscosity whereupon,
   vi) a topcoat layer of lacquer with an additive of 5 - 35% of hard particles with an average size in the range 50nm - 30μm is applied to a surface weight of 2 - 20g/m² whereupon,
   vii) the applied layers of lacquer are cured to a desired final viscosity.

2. A process according to claim 1, c h a r a c t e r i s e d in that the lacquer is a UV or electron beam curing acrylic, epoxy or maleimide lacquer.

3. A process according to claim 1, c h a r a c t e r i s e d in that the lacquer comprises a reaction mechanism selected from the group; cationic, free-radical, and thiol/ene, and is photo initiator free.

4. A process according to claim 1 or 2, c h a r a c t e r i s e d in that a second base layer of lacquer is applied to a surface weight of 5 - 50 g/m² on top of the sprinkled hard particles after the curing process and that a second layer of hard particles with an average particle size in the range 10 - 150 μm are sprinkled to an amount of 1 - 40 g/m² on the still wet lacquer of the second base layer and that the applied layer of lacquer is cured to a desired viscosity before applying the covering layer.

5. A process according to any of the claims 1 - 3, c h a r a c t e r i s e d in that the base layer is applied in several steps with intermediate curing to a desired viscosity, each step comprising application of lacquer to a surface weight of 5 - 40 g/m².

6. A process according to any of the claims 1 - 4 , c h a r a c t e r i s e d in that the covering layer is applied in several steps with intermediate curing to a desired viscosity, each step comprising application of lacquer to a surface weight of 5 - 40 g/m².

7. A process according to any of the claims 1 - 5, c h a r a c t e r i s e d in that the topcoat layer is applied in several steps with intermediate curing to a desired viscosity, each step comprising application of lacquer to a surface weight of 5 - 40 g/m².

ABSTRACTS:

A process for achieving a wear resistant translucent surface on surface elements (1) which comprises a decorative upper layer (2) and a supporting core (5). A number of layers of UV- or electron-beam curing lacquer are applied on a decorative surface, through a process comprising the steps;

i) Applying a base layer of lacquer to a surface weight of 5 - 50g/m².

ii) Applying hard particles with an average particle size in the range 10 - 150 µm which are sprinkled to an amount of 1 - 40 g/m² on the still wet lacquer.

iii) Curing the applied layer of lacquer to a desired viscosity.

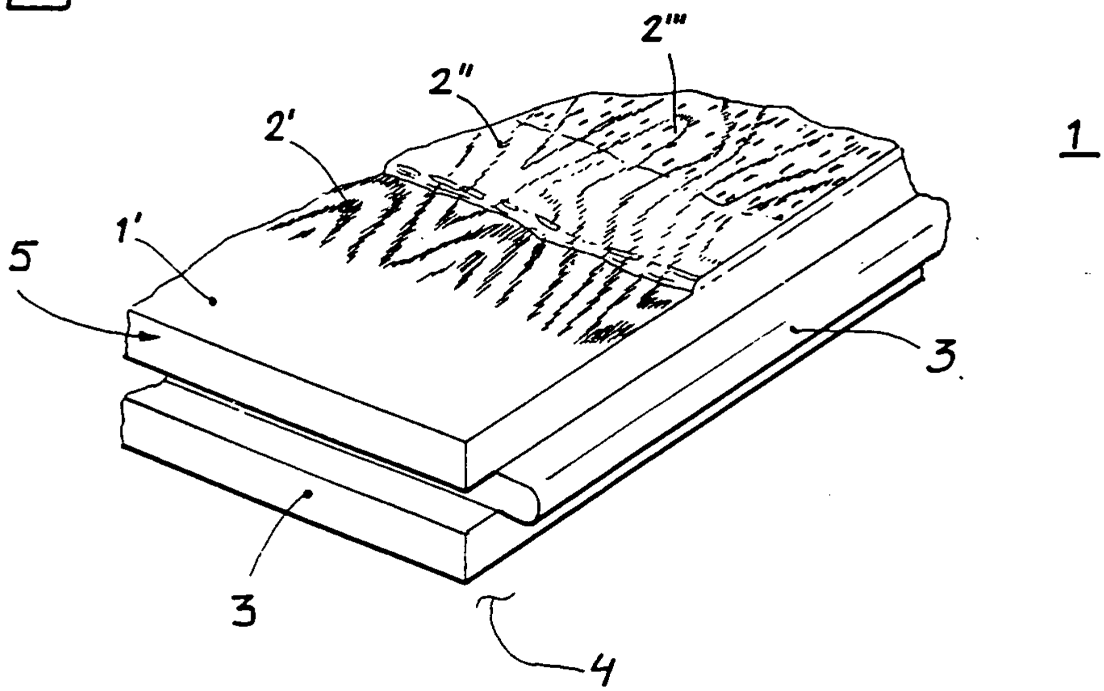
iv) Applying a covering layer of lacquer to a surface weight of 5 - 150 g/m².

v) Curing the applied layer of lacquer to a desired viscosity.

vi) Applying a topcoat layer of lacquer with an additive of 5 - 35% of hard particles with an average size in the range 50nm - 30µm to a surface weight of 2 - 20g/m².

vii) Curing the applied layers of lacquer to a desired final viscosity.

Fig.



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A process for achieving decor on surface elements.

The present invention relates to a process for achieving decor on surface elements having a decorative upper surface of which a decorative element may overlap several surface elements and will have an considerably improved matching of the décor between adjacent surface elements.

Products clad with thermosetting laminate is common in many areas nowadays. They are mostly used where the demands on abrasion resistance are high, and furthermore where resistance to different chemicals and moisture is desired. As examples of such products floors, floor skirting, table tops, work tops and wall panels can be mentioned.

The thermosetting laminate most often consist of a number of base sheets with a decor sheet placed closest to the surface. The decor sheet can be provided with a pattern by desire. Common patterns usually visualise different kinds of wood or mineral such as marble and granite.

One common pattern on floor elements is the rod pattern where two or more rows of rods of, for example wood, is simulated in the décor.

The traditional thermosetting laminate manufacturing includes a number of steps which will result in a random matching tolerance of up to ±5mm, which is considered to great. The steps included in the manufacturing of a laminate floor is; printing decor on a paper of α-cellulose, impregnating the decorative paper with melamine-formaldehyde resin, drying the decorative paper, laminating the decorative paper under heat and pressure together with similarly treated supporting papers, applying the decorative laminate on a carrier and finally sawing and milling the carrier to the desired format. All these steps in the manufacturing will cause a change in format on the decor paper. It will therefore be practically impossible to achieve a desired match of patterns between the elements of a without causing great amounts of wasted laminate. The thermosetting laminate is a rather costly part of a laminate floor.

It has, through the present invention, been made possible to overcome the above mentioned problems and a surface element with a decorative surface where the decorative pattern between different surface elements is matching has been obtained. The invention relates to a process for achieving décor on surface elements which comprises a decorative upper layer and a supporting core. The invention is characterised in that;

i) A selected main décor is entered via a terminal, the selected décor emanating from a group consisting of; an archetype digitised via digital camera or scanner and a digitised décor from a database.

ii) The dimensions of the surface to be covered by surface elements and the desired dimension of the décor is then entered into the terminal. Support programs are used for calculating the segmentation of the main décor to cover more than one surface element.

iii) The result of the selections and calculations is finally visualised via the terminal.

The digitised main décor is stored digitally in order to be used as a control function and original, together with control programs and selection parameters, when printing the décor.

It is, in order to enhance the decorative effect of some decor possible to select a surrounding décor. A décor effect in the border between the main décor and the surrounding décor is suitably also selected, the selection being made from the group; fading, sharp edge, sharp edge with shadow effect, jagged edge, jagged edge with shadow and surrounding inlay of other décor.

The surrounding décor is preferably processed as follows;

i) A segmentation pattern for the surrounding décor is selected. The segmentation comprising at least two décor segments on each surface element. The shape, as seen from above, of the surface element is preferably selected from the group; triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal. The shape of the surface elements with surrounding décor and the shape of the surface elements which, of course, is selected so that they can be joined with each other. The shape of the segments is selected from the group triangular, quadratic, rectangular, heptagonal, pentagonal, octagonal, circular, elliptical, perturbed and irregular.

ii) A segment décor is then selected for each segment. The segment décor is selected from the group; digitised and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor.

iii) Each selection is made on a terminal where the selections emanates from a data base. The selection is visualised via the terminal.

A décor effect in the border between the main décor and the surrounding décor is suitably selected. The selection is preferably made from the group; fading, sharp edge, sharp edge with shadow effect, jagged edge, jagged edge with shadow and surrounding inlay of other décor. Also this selection is made on the terminal.

The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and support programs calculates an installation pattern. The installation pattern calculation is preferably used for printing an assembly instruction. The installation pattern calculation is according to one embodiment of the invention used for printing a miniaturised copy of the calculated installation with the selected pattern and décor. This print out may serve as an evaluation copy of the design before making decisions regarding the manufacturing.

The dimensions of the surface to be covered by surface elements is entered into the terminal. Support programs further calculates décor and segmentation pattern matching between the surface elements. The selections is preferably used, together with support programs for controlling further steps in the manufacturing procedure selected from the group; identification marking, positioning marking, packaging, lacquering, surface embossing, storing and delivery logistics. An algorithm is preferably used for guiding the positioning of the décor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element. The control program is then preferably used together with décor data and selection parameters for applying matching identification on the surface elements.

It is also possible to manufacture a designed larger surface without any décor segments larger than a surface element by utilising the process as described below.

i) A segmentation pattern is selected, the segmentation comprising at least two décor segments on each surface element. The shape, as seen from above, of the surface element is hereby selected from the group; triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal while the shape of the segments is selected from the group triangular, quadratic, rectangular, heptagonal, pentagonal, octagonal, circular, elliptical, perturbed and irregular.

ii) A segment décor is then selected for each segment. The segment décor is selected from the group; digitised and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor.

iii) Each selection is made on a terminal where the selections emanates from a data base and that the selection is visualised via the terminal.

The décor is preferably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is preferably stored digitally in order to be used as a control function and original, together with control programs and selection parameters, when printing the décor.

The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and support programs calculates an installation pattern. The installation pattern calculation is suitably also used for printing an assembly instruction. In order to visualise the selection the installation pattern calculation is possibly used for printing a miniaturised copy of the calculated installation with the selected pattern and décor. The dimensions of the surface to be covered by surface elements is suitably entered into the terminal and that that support programs further calculates décor and segmentation pattern matching between the surface elements.

The selections is preferably also used, together with support programs for controlling further steps in the manufacturing procedure selected from the group; identification marking, positioning marking, packaging, lacquering, surface embossing, storing and delivery logistics.

An algorithm is suitably used for guiding the positioning of the décor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element. The control program is suitably used, together with

décor data and selection parameters, for applying matching identification on the surface elements.

The surface elements may be used as floor, wall or ceiling boards. The surface elements are suitably manufactured through the following process;

i) A supporting core with a desired format is manufactured and provided with an upper side and a lower side.

ii) The upper side of the supporting core is then provided with a décor, by for example printing. The décor is positioned after a predetermined fixing point on the supporting core.

iii) The upper side of the supporting core is then provided with a protecting, at least partly translucent, wear layer by for example spray coating, roller coating, curtain coating and immersion coating or by being provided with one or more sheets of α-cellulose impregnated with thermosetting resin or lacquer.

The décor is suitably achieved by digitisation of an actual archetype or by partly or completely being created in a digital media. The digitised décor is stored digitally in order to be used as a control function and original, together with possible control programs, when printing the décor.

The décor may accordingly be obtained by making a high resolution or selected resolution digital picture of the desired décor. This is suitably made by means of a digital camera or scanner. The most common décor will of course be different kinds of wood and minerals like marble, as these probably will continue to be preferred surface decoration in home and public environments. It is, however, possible to depict anything that is visible. The digitised version of the décor is then edited to fit the size of the supporting core. It is also possible to rearrange the décor in many different ways, like changing colour tones, contrast, dividing the décor into smaller segments and adding other decorative elements. It is also possible to completely create the décor in a computer equipped for graphic design. It is possible to create a simulated décor so realistic that even a professional will have great problems in visually separating it from genuine material. This makes it possible to make for example floor boards with an almost perfect illusion of a rare kind of wood, like ebony or rose wood and still preserving trees under threat of extermination.

The digital décor is used together with guiding programs to control a printer. The printer may be of an electrostatic type or an inc-jet type printer. Most often the colours yellow, magenta, cyan and black will be sufficient for the printing process, but in some cases it might be advantageous to add white. Some colours are difficult to achieve using the colours yellow, magenta, cyan, black and white whereby the colours light magenta and light cyan may be added. It is also possible to add so called spot colours where specific colour tones are difficult to achieve or where only certain parts of the colour spectrum with intermixing shades is desired. The resolution needed is much depending on the décor that is to be simulated, but resolutions of 10 - 1500 dots per inch (dpi) is the practical range in which most décor will be printed. Under normal conditions a resolution of 300 - 800 dpi is sufficient when creating simulations of even very complex decorative patterns and still achieve a result that visually is very difficult to separate from the archetype without close and thorough inspection.

The digitally stored décor can also be used together with support programs when guiding other operations and procedures in the manufacturing process. Such steps in the operation may include procedures like identification marking, packaging, lacquering, surface embossing, storing and delivery logistics as well as assembly instructions.

It is advantageous to manufacture the supporting core in the desired end user format and to provide it with edges suited for joining before applying the décor and wear layer, since the amount of waste thereby is radically reduced. The décor matching tolerances will also be improved further by this procedure.

The main part of the supporting core is suitably constituted by a particle board or a fibre board. It is, however, possible to manufacture the core that at least partly consist of a polymer such as for example polyurethane or a polyolefin such as polyethylene, polypropylene or polybutene. A polymer based core can be achieved by being injection moulded or press moulded and can be given its shape by plastic moulding and does therefore not require any abrasive treatment. A polymer based core may except polymer also contain a filler in the form of a particle or fibre of organic or inorganic material, which besides the use a cost reducing material also

will be used to modify the mechanical characteristics of the core. As an example of such suitable fillers can be mentioned; cellulose or wood particles, straw, starch, glass, lime, talcum, stone powder and sand. The mechanical characteristics that may be changed is for example viscosity, thermal coefficient of expansion, elasticity, density, fire resistance, moisture absorption capacity, acoustic properties, thermal conductivity, flexural and shearing strength as well as softening temperature.

The upper surface, i.e. the surface that is to be provided with décor, is suitably surface treated before the printing. Such surface treatment will then incorporate at least one of the steps, ground coating and sanding. It is also possible to provide the surface with a structure that matches the décor that is to be applied.

The translucent wear layer is suitably constituted by a UV- or electron beam curing lacquer such as an acrylic, epoxy, or maleimide lacquer. The wear layer is suitably applied in several steps with intermediate curing where the last one is a complete curing while the earlier ones are only partial. It will hereby be possible to achieve thick and plane layers. The wear layer suitably includes hard particles with an average particle size in the range 50 nm - 150 μm. Larger particles, in the range 10 μm - 150 μm, preferably in the range 30 μm - 150 μm, is foremost used to achieve abrasion resistance while the smaller particles, in the range 50 nm - 30 μm, preferably 50 nm - 10 μm is used for achieving scratch resistance. The smaller particles is hereby used closest to the surface while the larger ones are distributed in the wear layer. The hard particles are suitably constituted of silicon carbide, silicon oxide, α-aluminium oxide and the like. The abrasion resistance is hereby increased substantially. Particles in the range 30 mm - 150 mm can for example be sprinkled on still wet lacquer so that they at, least partly, becomes embedded in finished wear layer. It is therefore suitable to apply the wear layer in several steps with intermediate sprinkling stations where particles are added to the surface. The wear layer can hereafter be cured. It is also possible to mix smaller particles, normally particle sizes under 30 μm with a standard lacquer. Larger particles may be added if a gelling agent or the like is present. A lacquer with smaller particles is suitably used as top layer coatings, closer to the upper surface. The scratch resistance can be improved by sprinkling very small particles in the range 50 nm - 1000 nm on the uppermost layer of lacquer. Also these, so called nano-particles, can be mixed with

lacquer, which with is applied in a thin layer with a high particle content. These nano-particles may besides silicon carbide, silicon oxide and α-aluminium oxide also be constituted of diamond.

According to one embodiment of the invention, the translucent wear layer is constituted of one or more sheets of α-cellulose which are impregnated with melamine-formaldehyde resin. These sheets are joined with the core under heat and pressure whereby the resin cures. It is, also in this embodiment, possible to add hard particles with an average particle size in the range 50 nm - 150 μm. Larger particles, in the range 10 μm - 150 μm, preferably 30 μm - 150 μm is foremost used to achieve abrasion resistance while the smaller of the particles, in the range 50 nm - 30 μm, preferably 50 nm - 10 μm, is used to achieve scratch resistance. The smaller particles is hereby used on, or very close to, the top surface while the larger particles may be distributed in the wear layer. Also here the particles advantageously are constituted of silicon carbide, silicon oxide, α-aluminium oxide, diamond or the like of which diamond, of cost reasons only is used as particles smaller than 1 μm. The sheets of α-cellulose is hereby suitably pressed together with the rest of the surface element in a continuos belt press with two steel belts. The pressure in the press is hereby suitably 5 - 100 Bar, preferably 20 - 80 Bar. The temperature is suitably in the range 140 - 200 °C, preferably 160 - 180 °C. It is also possible to utilise a discontinuous process where a number of surface elements can be pressed in a so called multiple-opening press at the same time. The pressure is then normally 20 - 150 Bar, preferably 70 - 120 Bar, while the temperature suitably is 120 - 180 °C, preferably 140 - 160 °C.

The décor on the surface elements is suitably constituted by a number of décor segments with intermediate borders, which borders, on at least two opposite edges coincides with intended, adjacent surface elements.

It is also desirable to provide the surface elements with a surface structure intended to increase the realism of the décor of the surface elements. This is suitably achieved by positioning at least one surface structured matrix, forming at least one surface structure segment on a corresponding décor segment or number of décor segments on

the decorated surface of the surface element in connection to the application of wear layer. This matrix is pressed towards the wear layer whereby this will receive a surface with structure that enhances the realism of the décor.

When simulating more complex patterns, like wood block chevron pattern or other décor with two or more divergent and oriented décor, it is suitable to use at least two structured matrixes which forms one structure segment each. The structure segment are here independent from each other in a structure point of view. The surface structure segments are intended to at least partly but preferably completely match the corresponding décor segments of the décor. The surface structure segments are accurately positioned on the décor side of the surface element in connection to the application of the wear layer, and is pressed onto this whereby the wear layer is provided with a surface structure where the orientation of the structure corresponds to the different directions in the décor.

One or more matrixes preferably forms the surface of one or more rollers. The surface element is then passed between the roller or rollers and counter stay rollers, with the décor side facing the structured rollers. The structured rollers are continuously or discontinuously pressed towards the décor surface of the surface element.

Rollers containing two or more matrixes, is suitably provided with a circumference adapted to the repetition frequency of change of direction in the décor.

It is also possible to apply the structure matrixes on the surface of a press belt. The surface element is then passed between the press belt and a press belt counter stay under continuous or discontinuous pressure between the structured press belt and the press belt counter stay.

It is, according to one alternative procedure, possible to have one or more matrixes form the structure surface of one or more static moulds which momentary is pressed towards the decorative side of the surface element.

According to one embodiment of the invention, particularly characteristic décor segments such as borderlines between simulated slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor, is stored as digital data. Said data is used for guiding automated engraving or pressing tools when providing said characteristic décor segments with a suitable surface structure,

and that said engraving tool or pressing tool is synchronised via the predetermined fixing point on the surface element.

The process described in the present application, for manufacturing surface elements is very advantageous from a logistic point of view since the number of steps when achieving a new décor is radically reduced. It is, according to the present invention possible to use digitally created or stored data for directly printing the décor on a surface element by using a ink-jet printer or a photo-static printer. The so-called set up time will thereby be very short, whereby even very special customer requirements may be met at a reasonable cost. It is according to the present invention possible to manufacture, for example, a world map in very large format, stretching over a great number of surface elements without any disrupting deviations in décor matching, to mainly the same cost as bulk produced surface elements. Since the décor may be handled digitally all the way to the point of being applied to the surface of the core, set up times will be practically non-existent while at the same time a high degree of automation will be practicable. It is also possible to automatically provide the surface elements with identification and orientation marking which would make the installation of complex décor, like world maps in the example above, much easier. This has so far been impossible.

Surface elements manufactured as described above is suitably used as a floor covering material where the demands on stability and scratch and abrasion resistance is great. It is, according to the present invention, also possible to use the surface elements as wall and ceiling decorative material. It will however not be necessary to apply thick wear layer coatings in the latter cases as direct abrasion seldom occurs on such surfaces.

The invention is described further in connection to an enclosed figure, embodiment examples and schematic process descriptions showing different embodiments of the invention.

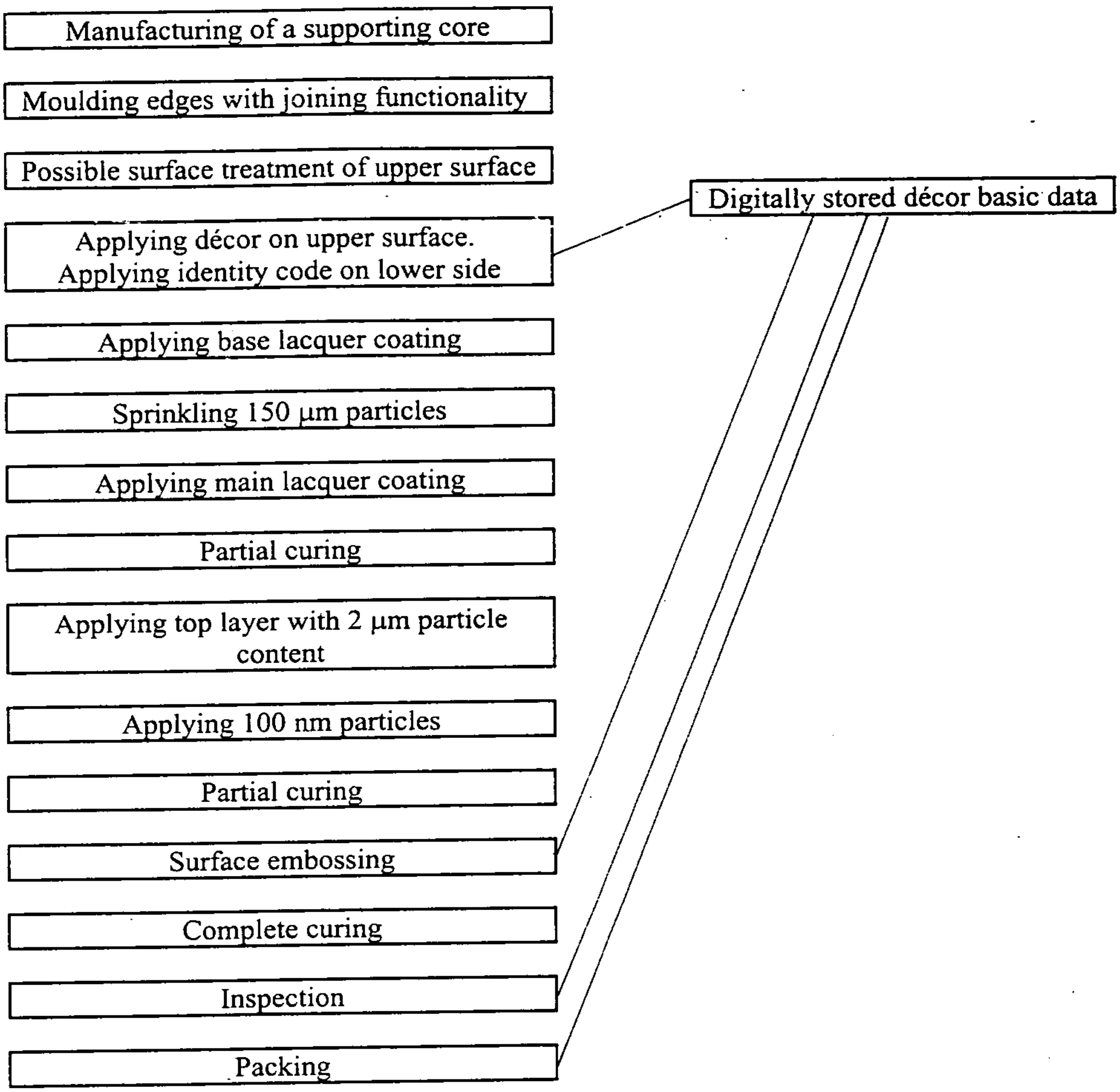
Accordingly, the figure shows parts of a surface element 1 which includes an upper decorative layer 2, edges 3 intended for joining, a lower side 4 and a supporting core 5. The process is initiated by manufacturing a supporting core 5 with a desired format and edges 3 intended for joining. The supporting core 5 is further provided

with an upper side 1' suited for printing and a lower side 4. The upper side 1' of the supporting core 5 is then provided with a décor 2' by printing, utilising an inc-jet printer. The décor 2' is oriented after a predetermined fixing point on the supporting core 5. The upper side 1' of the supporting core 5 is then provided with a protecting translucent wear layer 2" through curtain coating. The supporting core 5 is constituted by particle board or fibre board. The translucent wear layer 2" is constituted by a UV-curing acrylic lacquer which is applied in several steps with intermediate curing, of which the last one is a complete curing while the earlier ones are only partial curing. The wear layer 2" also includes hard particles of α-aluminium oxide with an average particle size in the range 0,5μm - 150μm.

A surface structured matrix is positioned and pressed towards the décor side of the surface element 1 before the final curing of the acrylic lacquer whereby the surface of the wear layer 2" receives a surface structure 2"' which enhances the realism of the décor 2'.

It is also possible to utilise two or more surface structured matrixes, each forming a structure segment, between which the structure is independent, which will make it possible to simulate the surface structure of, for example, wood block chevron pattern décor.

Process scheme 1.



A supporting polymer and filler based core is manufactured in the desired format and is provided with an upper side, a lower side and edges provided with joining members, such as tongue and groove. The upper side of the supporting core is then sanded smooth after which a primer is applied. A décor is then applied on the upper side by means of a digital photo-static five colour printer. The colours are magenta, yellow, cyan, white and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length is selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a supporting core. The digital image of the wood blocks are then classified after wood grain pattern and colour so that a number of groups is achieved. The groups are; fair wood with even grain, dark wood with even grain, fair wood with knots and flaws, dark wood with knots and flaws, fair cross-grained wood and finally dark cross-grained wood. Each group contains five different block simulations. An algorithm is feed into a computer which is used for the guiding of the printing operation so that the simulated wood blocks is digitally placed in three longitudinal rows and mixed so that two similar wood blocks never is placed next to each other. The algorithm will also guide the position of the latitudinal borderlines between the simulated wood blocks so that they are unaligned with more than one block width between adjacent rows. It will also guide the latitudinal position of the borderlines so that it either aligns with the shorter edges of the supporting core or is unaligned with more than one block width. Another printer, also guided by the computer, is utilised for printing a running matching number on the lower side short side edges. The décor will hereby continue longitudinally over the surface elements and a perfect matching is obtained when the surface elements are placed in numerical order.

A basic layer of UV-curing acrylic lacquer is then applied by means of a rollers. Particles with an average particle size in the range 150 μm is then sprinkled onto the still wet basic layer, whereby the main layer of UV-curing acrylic lacquer is applied by spray coating. The two layers of lacquer are then partly cured using UV-light whereby the viscosity of the lacquer increases. A top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 2 μm, is then applied by means of a roller. Hard particles with an average size of 100 nm is then sprinkled on top of the wet top layer, whereby the lacquer is partly cured with UV-light so that the viscosity increases. The still soft lacquer is then provided with a structure in the form of narrow, small, elongated recesses, simulating the pores of the wood. This will increase the realism of the décor. This is achieved by alternate between two different structured roller per row of simulated wood blocks. The

structure of the rollers simulates even wood grain and cross-grained wood respectively. The rollers are alternately pressed towards the lacquered surface while it passes. The positioning of the rollers are guided via the digitally stored data used for printing the décor as well as the fixing point used there.

It is according to one alternative embodiment possible to utilise one or more static moulds with surface structure which momentary is pressed towards the décor side.

Especially characteristic décor segments such as borderlines between slabs, bars, blocks or the like and also knots, cracks, flaws and grain which is visually simulated in the décor, is suitably stored as digital data. This data is achieved by processing selected parts of the simulated wood blocks so that guiding data is achieved. Said data is then used for guiding an automated robot provided with an engraving tool or a press mould which provides the surface of the lacquer with a structure that matches said characteristic décor segments. The operation is also here synchronised via by the predetermined fixing point on the supporting core.

The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface elements may be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

The process above will make it possible to have a completely customer driven manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear to anyone skilled in the art, that a décor is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data. This will make it logistically possible to manufacture customer designed décor. Such a process is exemplified as follows;

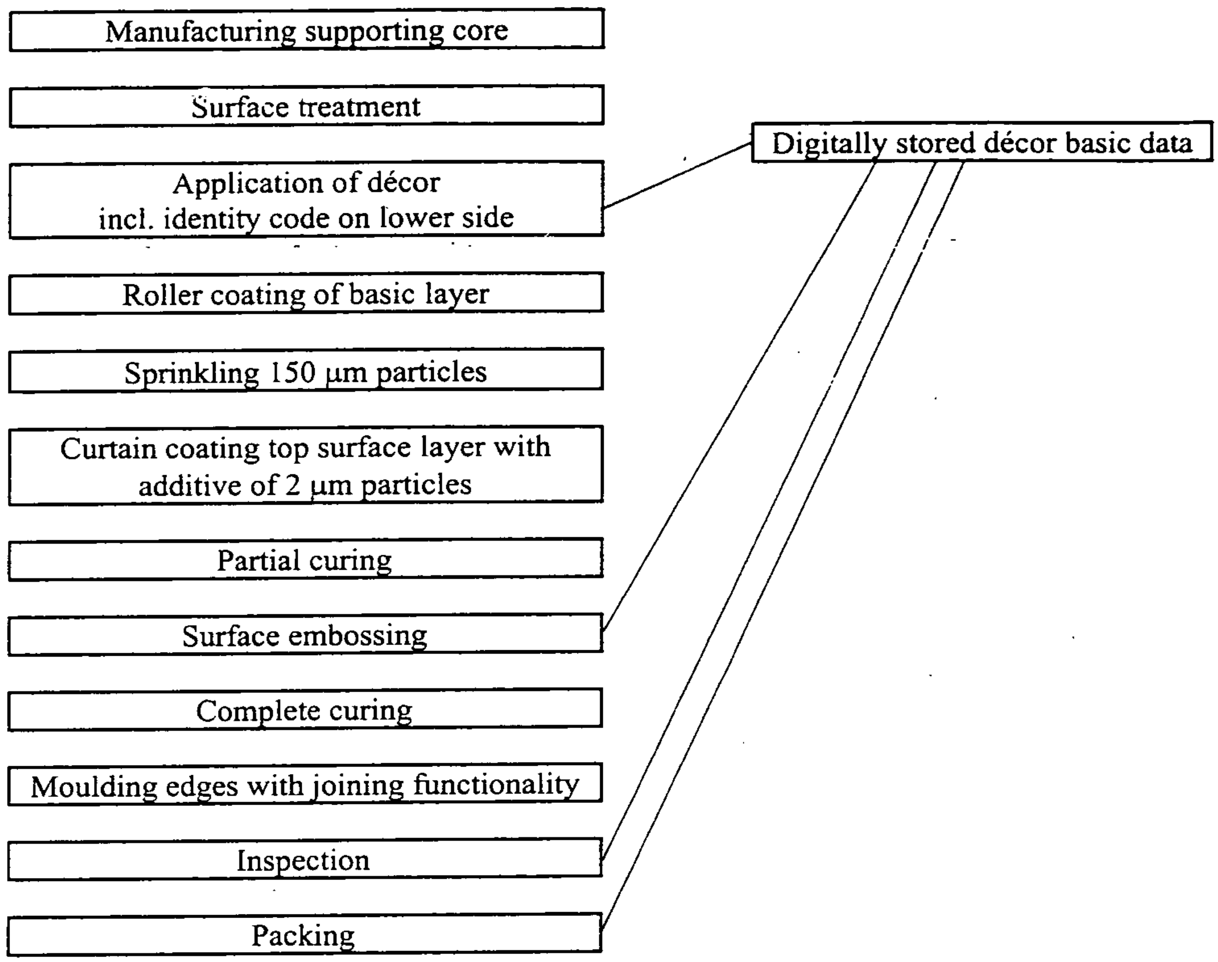
The customer utilises a database via Internet or at a local dealer. It is also possible for another operator utilise a database. The database contains samples and/or reduced resolution copies of a great variety of standard décor which can be combined after predetermined parameters.

The parameters may, for example, concern a single surface element where, for example, chevron pattern, diamond pattern and block pattern may be the choices of décor segmentation. It will here be possible to select a set of different simulations to randomly or by selected parameters fill the segments, for example, marble, birch and mahogany. The customer may also add an inlay from a design of his own which is digitised and processed, preferably automatically, to a desired format and resolution.

The parameters may alternatively include décor segments that requires the space of several surface elements, for example a map over the world. The parameters may here further include fading of the larger design to a surrounding décor, surrounding frame of other décor etc.

The customers enters the measurements of the surface that is to be covered by the surface elements. The customer then makes selections from the database and is able to see his selection as a completed surface, either on screen or by printing. The visualisation program used, is suitably also used for calculating installation pattern and presenting installation instructions with identification numbers on surface elements and where to cut the elements in order to make a perfect match. The surface elements may also be provided with removable matching lines on the decorative side making matching of décor between adjacent rows easier. The customer or dealer may then confirm his order via electronic mail where the pattern and décor is reduced to a code sequence and the order can be the direct input to the computer guiding the manufacturing process as described above. The customer and/or dealer data follows the manufacturing process all the way to packaging and a fully customer guided manufacturing process is achieved.

Process scheme 2



A supporting fibre board based core is manufactured in the desired format and is provided with an upper side, a lower side and edges. The upper side of the supporting core is then sanded smooth after which a white primer is applied. A décor is then applied on the upper side by means of a digital inc-jet four colour printer. The colours are magenta, yellow, cyan and black. The décor is positioned from a predetermined fixing point in form of a corner of the supporting core, while the décor direction is aligned with the long side edge initiating from the same corner.

The basis for the décor is stored as digital data. This digital data has been achieved by digitising a number of wood grain patterns with a digital camera. A number of rectangular blocks with a fixed width, but of varying length are selected and parted from the digital wood grain pictures. The width of the rectangular blocks is selected so that three block widths equals the width of a finished surface element. The digital

image of the wood blocks are then joined digitally to form a rectangular surface of a specified size, for example, 200 x 1200 mm. A selected amount of such combinations of different blocks are designed as described above so that a number of slightly different rectangular surfaces is achieved. The printer, or preferably a set of printers are positioned so that a desired number of rectangular décor surfaces with a specified intermediate distance is printed on the supporting core. The intermediate distance between the rectangular surfaces is the distance needed for parting and moulding of edges. The décor printer or printers are also used for printing fixing points at predetermined positions. Another printer, also guided by the computer, is utilised for printing an identity code on the lower side of each intended finished surface element.

A basic layer of UV-curing acrylic lacquer is then applied by means of rollers. Particles with an average particle size in the range 150 μm is then sprinkled onto the still wet basic layer, whereby a top layer of UV-curing acrylic lacquer with an additive in the form of hard particles with an average size of 2 μm, is applied by means of a roller. Hard particles with an average size of 100 nm is then sprinkled on top of the wet top layer, whereby the lacquer is partly cured with UV-light so that the viscosity increases. The still soft lacquer is then provided with a structure in the form of narrow, small, elongated recesses, simulating the pores of the wood. This will increase the realism of the décor. This is achieved by pressing rollers towards the lacquered surface while it passes. The positioning of the rollers are guided via the digitally stored data used for printing the décor, as well as the fixing point used there when more complex and completely matching surface structures as described together with process scheme 1 is desired.

The lacquer is then completely cured with UV-light to desired strength, whereby the finished surface element is cut into the predetermined formats which are provided with edges with joining functionality are moulded by milling. The cutting and edge moulding process is positioned from fixing point printed close to the décor. The surface elements may then be inspected by the naked eye or by a digital camera supported by a computer. The surface elements are then packed in batches and provided with identification markings.

It is, according to an alternative procedure in the process, possible to cut and mould the edges at an earlier stage in the process. It is suitable to apply and cure a protecting layer of lacquer on top of the printed décor followed by cutting and

moulding of the edges. The remaining and main part of the wear layer is then applied as described in connection to process scheme 1 or 2 above.

The process above will make it possible to have a customer initiated manufacturing where even very small quantities may be produced with the same efficiency as bulk manufacturing. Even though only one décor is described in connection to the process scheme above, it becomes clear anyone skilled in the art, that décor is changed very easily in the process. All of the important steps of the manufacturing such as printing, structuring, inspection, packaging and identification marking may be controlled and supervised by central processing data.

The invention is also described through embodiment examples.

EXAMPLE 1.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 30g/m² of UV-curing acrylic lacquer by means of roller coating. 20g/m² of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30g/m² of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20g/m² of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate partial curing as a above. Each of the three layers had a surface weight of 20g/m². The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly

cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of $10g/m^2$. The top-coat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second layer of the topcoat lacquer was then applied and partly cured as described above. The wear layer was then provided with a surface structure by means of a surface structured roller. A third layer of the topcoat formulation was then applied on top of the structured wear layer. Also the third layer of top coat was applied to a surface weight of $10g/m^2$. The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 7100 turns was obtained. An IP value of 7100 turns is fully sufficient for floor covering materials with medium to heavy traffic like hotel lobbies, hallways and the like.

EXAMPLE 2.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer. The build up of a wear layer was then initiated by applying $30g/m^2$ of UV-curing acrylic lacquer by means of roller coating. $20g/m^2$ of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another $30g/m^2$ of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another $20g/m^2$ of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of $20g/m^2$. The hard particles were completely embedded in the lacquer after

the three layers were applied and a plane upper wear layer surface was achieved. Also the uppermost of the three layers of lacquer was cured to a desired viscosity.

A second décor layer was then printed on top of the wear layer. The second décor layer, which was identical to the first décor closest to the core, was oriented and positioned so that it completely matched the first décor.

The build up of an upper wear layer was then initiated by applying 30g/m² of UV-curing acrylic lacquer by means of roller coating. 20g/m² of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Another 30g/m² of UV-curing acrylic lacquer was then roller coated onto the already applied layer after which another 20g/m² of α-aluminium oxide particles with an average particle size of 70μm were sprinkled on the still sticky second coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. Three layers of UV-curing acrylic lacquer was then applied by roller coating with intermediate curing as a above. Each of the three layers had a surface weight of 20g/m². The hard particles were completely embedded in the lacquer after the three layers were applied and a plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The top-coat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of 10g/m². The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. A second layer of the topcoat lacquer was then applied and partly cured as described above. The wear layer was then provided with a surface structure by means of a surface structured roller. A third layer of the topcoat formulation was then applied on top of the structured wear layer. Also the third layer of top coat was applied to a surface weight of 10g/m². The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 13500 turns was obtained. An IP value of 13500 turns is fully sufficient for floor covering materials with heavier traffic like airports, railway stations and the like. The second layer of décor and wear layer will add abrasion resistance without having obtained an unwanted hazy effect in the décor.

EXAMPLE 3.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 15g/m² of UV-curing acrylic lacquer by means of roller coating. 20g/m² of hard particles made of α-aluminium oxide with an average particle size of 70μm were sprinkled on the still sticky lacquer. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. One layer of UV-curing acrylic lacquer was then applied by roller coating and was partially cured as above. The layer had a surface weight of 40g/m². The hard particles were embedded in the lacquer after the layer of lacquer was applied and a mainly plane upper wear layer surface was achieved.

A top coating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layers. The topcoat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of 10g/m². The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. The wear layer was then provided with a surface structure by means of a surface structured roller. A second, final layer of the topcoat formulation was then applied on top of the structured wear layer. Also the second layer of top coat was applied to a surface weight of 10g/m². The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 3100 turns was obtained. An IP value of 3100 turns is fully

sufficient for floor covering materials with light traffic like bedrooms, living rooms and the like.

EXAMPLE 4.

A supporting core of medium density fibre board were sanded smooth. A layer of primer lacquer were applied on top of the fibre board. The primer were cured after which a decor was printed on top of the primer.

The build up of a wear layer was then initiated by applying 50g/m² of UV-curing acrylic lacquer which contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm by means of roller coating. The lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased.

A topcoating procedure was then initiated. A first layer of UV-curing acrylic topcoat lacquer was applied by means of a roller coater on top of the previous, partly cured, layer. The top-coat lacquer contained 10% by weight of hard particles of α-aluminium oxide with an average particle size of 10μm. The first layer was applied to a surface weight of 10g/m². The topcoat lacquer was then exposed to a predetermined energy amount of UV-light so that it cured only partly and the viscosity was increased. The wear layer was then provided with a surface structure by means of a surface structured roller. A second, final layer of the top-coat formulation was then applied on top of the stuctured wear layer. Also the second layer of top coat was applied to a surface weight of 10g/m². The wear layer was then exposed to a predetermined energy amount of UV-light so that it cured completely.

The wear layer was then tested for abrasion resistance according to ISO 4586/2-88, where an IP value of 300 turns was obtained. An IP value of 300 turns could be sufficient for floor covering materials with light traffic like bedrooms, living rooms and the like.

The invention is not limited to the embodiments shown as these can be varied in different ways within the scope of the invention. It is for example possible to use so-called overlay sheets of α-cellulose impregnated with thermosetting resin instead

of acrylic lacquer in the process described in connection to process scheme 1 and in particular in the process described in connection to process scheme 2. These sheets of a-cellulose which are impregnated with melamine-formaldehyde resin is joined with the supporting core through heat and pressure, whereby the resin cures. The wear resistance may also in this embodiment be improved by adding hard particles in the range 50 nm - 150μm to the wear layer.

CLAIMS

1. A process for achieving décor on surface elements (1) which comprises a decorative upper layer (2) and a supporting core (5), characterised in that;
   i) a selected main décor is entered via a terminal, the selected décor emanating from a group consisting of; an archetype digitised via digital camera or scanner and a digitised décor from a database and that,
   ii) the dimensions of the surface to be covered by surface elements (1) and the desired dimension of the décor is entered into the terminal and that support programs is used for calculating the segmentation of the main décor to cover more than one surface element and that,
   iii) the result of the selections and calculations is visualised via the terminal.

2. A process according to claim 1, characterised in that the digitised main décor (2') is stored digitally in order to be used as a control function and original, together with control programs and selection parameters, when printing the décor (2').

3. A process according to claim 1, characterised in that a surrounding décor is selected.

4. A process according to claim 3, characterised in that a décor effect in the border between the main décor and the surrounding décor is selected, the selection being made from the group; fading, sharp edge, sharp edge with shadow effect, jagged edge, jagged edge with shadow and surrounding inlay of other décor.

5. A process according to claim 3, characterised in that
   i) a segmentation pattern for the surrounding décor is selected, the segmentation comprising at least two décor segments on each surface element (1), wherein the shape, as seen from above, of the surface element (1) is selected from the group; triangular, quadratic, rectangular, heptagonal, pentagonal and octagonal while the shape of the segments is selected from the group triangular, quadratic, rectangular, heptagonal, pentagonal,

octagonal, circular, elliptical, perturbed and irregular and that,

ii) a segment décor is selected for each segment, wherein the segment décor is selected from the group; digitised and simulated depiction of different kinds of wood, minerals and stone, different kinds of fabric, art work and fantasy based décor and that,

iii) each selection is made on a terminal where the selections emanates from a data base and that the selection is visualised via the terminal.

6. A process according to claim 4, characterised in that a décor effect in the border between the main décor and the surrounding décor is selected, the selection being made from the group; fading, sharp edge, sharp edge with shadow effect, jagged edge, jagged edge with shadow and surrounding inlay of other décor.

7. A process according to any of the claims 1 - 6, characterised in that the dimensions of the surface to be covered by surface elements (1) is entered into the terminal and that support programs calculates an installation pattern.

8. A process according to claim 7, characterised in that the installation pattern calculation is used for printing an assembly instruction.

9. A process according to claim 7, characterised in that the installation pattern calculation is used for printing a miniaturised copy of the calculated installation with the selected pattern and décor.

10. A process according to claim 3 or 5, characterised in that the dimensions of the surface to be covered by surface elements (1) is entered into the terminal and that support programs further calculates décor and segmentation pattern matching between the surface elements (1).

11. A process according to any of the claims 1 - 7, characterised in that the selections is used, together with support programs for controlling further steps in the manufacturing procedure selected from the group; identification marking, positioning marking, packaging, lacquering, surface embossing, storing and delivery logistics.

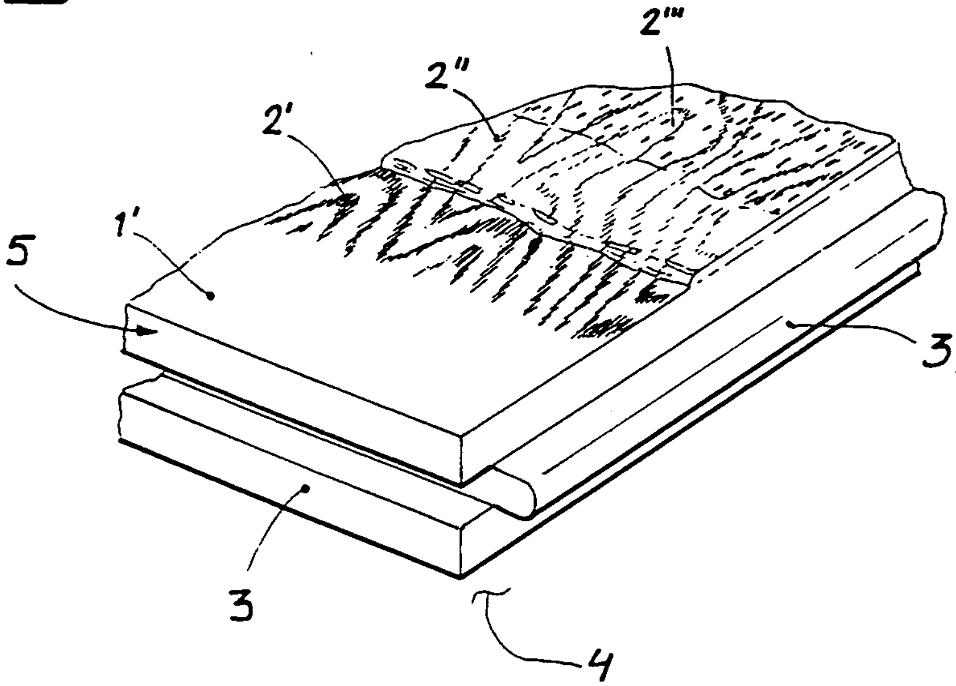
12. A process according to any of the claims 3 or 5, characterised in that an algorithm is used for guiding the positioning of the décor segments and segmentation pattern so that a décor segment from one surface element may continue on an adjoining surface element.

13. A process according to any of the claims 1 - 7, characterised in that the control program is used together with décor data and selection parameters for applying matching identification on the surface elements (1).

ABSTRACTS:

A process for achieving décor on surface elements (1) which comprises a decorative upper layer (2) and a supporting core (5). A selected main décor is entered via a terminal, the selected décor emanating from the group consisting of; an archetype digitised via digital camera or scanner and a digitised décor from a database. The dimensions of the surface to be covered by surface elements (1) and the desired dimension of the décor is entered into the terminal. Support programs is then used for calculating the segmentation of the main décor to cover more than one surface element. The result of the selections and calculations is visualised via the terminal.

Fig.



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